SCHOOLEY CALDWELL

ARCHITECTURE. INSPIRED.

DATE: 10/11/2023

JOB #: 22160.00

PROJECT MANUAL

100% Design Development Documents

COLUMBUS METROPOLITAN LIBRARY

Barnett Branch Addition/Renovation

3434 E. Livingston Avenue
Columbus, OH 43227

Prepared for

Columbus Metropolitan Library Board of Trustees
96 S. Grant Avenue
Columbus, OH 43215

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Columbus, Ohio 43215

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DOCUMENT 00 01 10

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SECTION 01 10 00
SUMMARY OF WORK

PART 1 – GENERAL

1.01 SUMMARY

A. SECTION TO BE PROVIDED BY CMR

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 – GENERAL

1.01 SUMMARY

A. Provide price for each alternate on the Bid Proposal Form. Include cost of modifications to other work to accommodate each alternate. Include related costs such as overhead and profit.

B. Alternates are described briefly in this section. The Contract Documents also define the requirements for alternates.

C. Coordinate pertinent related work and modify surrounding work as required to properly integrate the work under each alternate and to provide the complete construction required by Contract Documents.

D. Related Sections include the following:

1. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 DEFINITION

A. An alternate is an amount proposed by Bidders and stated on the Bid Proposal Form that will be added to or deducted from Base Bid amount if the Owner decides to accept a corresponding change in either scope of Work or in products, materials, equipment, systems or installation methods described in Contract documents.

B. Accepted alternates will be identified in the Contract.

1.03 COORDINATION

A. Coordinate related Work and modify or adjust adjacent work as required to ensure that Work affected by each accepted alternate is complete and fully integrated in to the project.

B. Immediately following Contract award, prepare and distribute to each party involved, notification of the status of the Alternate, indicating whether alternate has been accepted, rejected or deferred for consideration at a later date.

1.04 DESCRIPTION OF REQUIREMENTS

A. This section identifies alternate by number and describes the basic changes to be incorporated into the work, only when that alternate is made a part of the Work by specific provisions in the Contract.

B. Referenced sections of specifications stipulate pertinent requirements for products and methods to achieve the work stipulated under the alternate.

C. Include all applicable alternates requested in the Bid Proposal Form.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 SCHEDULE OF ALTERNATES

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

B. Bids shall be based on materials, equipment and systems required by the Contract Documents without exception.

C. The products specified in the Contract Documents establish a standard of required function, dimension, appearance, and quality.

D. Subcontractors wishing to obtain approval to bid non-specified products shall submit written requests to the Architect through the Construction Manager on the Product Approval Request Form included as an attachment to this Section before the date and time indicated on Form 01 25 00A.

1. Each Product Approval Request Form shall include the name of the specified manufacturer and product and a complete description of the proposed product including manufacturer's name and model number or system proposed, drawings, product literature, performance and test data, color selections or limitations, and any other information necessary for evaluation. Include a statement indicating any changes in other materials, equipment, or other work that would be required if the proposed product is incorporated in the work. The burden of proof of the merit of the proposed product is on the proposer. The Architect's decision of approval of a proposed product will be final.
2. The following will be cause for rejection of a Product Approval Request Form:

    a. Requests submitted by suppliers and individuals other than prime subcontractors.
    b. Requests submitted without adequate documentation.
    c. Requests submitted without the specified Product Approval Request Form.
    d. Requests received after the specified cut-off date.

3. When the Architect approves a product submission before receipt of bids, the approval will be included in an Addendum and bidders may include the pricing of this product in their bids. Bidders shall not rely on approvals made in any other manner.

E. Specifications are generally written using the following methods:

1. Performance: Where products are identified only by standard performance criteria and reference standards such as Federal Specifications or ASTM numbers, Contractor may bid any item conforming to the material, performance, and specification criteria indicated.
2. Manufacturer Listing: Where specifications specify more than one manufacturer for a product or material, the first manufacturer listed indicates the product or material used as the basis of design for the project. Using one of the other specified manufacturers or products does not relieve the Contractor of the responsibility of the product or material meeting specified requirements. If one of the other listed manufacturers is selected for use by the Contractor for the project, certify the product meets specified requirements, and its performance, operation, size, finish, warranty, accessories, and other specified qualities are equivalent or superior to the specified product, as determined by the Architect.
3. Proprietary: Where specifications specify only one particular manufacturer's product, that product is the basis of the contract without exception.

F. Related Sections include the following:

1. Section 01 25 00A – Product Approval Request Form
2. Section 01 33 00 – Submittal Procedures (Subcontractor’s and Supplier’s List)
3. Section 01 77 00 – Closeout Procedures

1.02 DEFINITIONS

A. Products: The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

B. Substitutions: Changes in materials, equipment, and systems from those required by the Contract Documents and proposed by subcontractor.

1.03 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration.

1. Substitution Request Form: Use Product Approval Request Form (Section 01 25 00A).
2. Documentation: Show compliance with requirements for substitutions.

B. Due Date: Product Approval Request Forms (01 25 00A) must be received by the Architect before the date and time indicated on this form.

PART 2 – PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

A. Conditions: Architect will consider subcontractor's request for substitution after contract award when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents, meets specified requirements, and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. If requested substitution involves more than one subcontractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all subcontractors involved.

PART 3 – EXECUTION

Not Used

END OF SECTION

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3434 East Livingston Avenue
Columbus, OH 43227

SECTION 01 25 00A

SUBSTITUTION REQUEST FORM

TO: Schooley Caldwell Associates

c/o ereilly-sanders@schooleycaldwell.com

PROJECT: **CML BARNETT BRANCH LIBRARY ADDITION/RENOVATION**

SC Project No. 22160.00
Due Date: December __, 2023, at 5:00 p.m.
(*refer to Section 01 25 00)*

A proposed substitution cannot legally be included in a bid or used in the Work until it appears in an Addendum or other Contract Modification as defined in the General Conditions. See "Invitation to Bid" and Section 01 60 00 – Product Requirements.

PROVIDE THE FOLLOWING INFORMATION. FAILURE TO PROVIDE THE INFORMATION COMPLETELY WILL BE CAUSE FOR REJECTION OF THE SUBSTITUTION.

SPECIFIED PRODUCT:

Specified Product: _____

Specified Manufacturer: _____

Specification Section: _____ Page: _____ Article: _____ Paragraph: _____

PROPOSED PRODUCT:

Product Name: _____

Manufacturer Name: _____

Manufacturer Web site: _____

QUESTIONS:

Answer the following questions using a separate attachment:

In your opinion, is the proposed product equivalent to the specified product?

Are the product characteristics the same as the specified product? (Dimensions, material properties?)

Are the product warranties the same? If not, list differences (Include attachment documenting warranty).

Does the proposed product require modifications to the building construction details?

Color: Is the same color available at no upcharge? Is another color selection required that doesn't match the specified product?

Will the construction time be affected if this proposed product is approved?

Has the proposed product been used locally?

Name of Facility: _____

Address: _____

Contact Person: _____ Phone: _____

Is product represented locally?

Supplier/Representative: _____ Phone: _____

Are approved installer(s) available locally?

Approved Installer(s): _____

Provide an attachment that lists a minimum of three similar projects completed by each installer. Include contact name and telephone number.

ATTACHMENTS:

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other

Include the following attachments:

1. Copy of the Project Manual Section where the proposed equal product would be specified, rewritten or red-lined to include any changes necessary to correctly specify the proposed equal product. Identify completely changes necessary to the original Project Manual Section.
2. Copies of details, elevations, cross-sections, and other elements of the Construction Drawings redone as necessary to show changes necessary to accommodate proposed equal product. Identify completely the changes from the original Drawings.
3. Complete product literature and technical data, installation and maintenance instructions, test results, and other information required to show complete conformance with requirements of the Contract Documents.

CERTIFICATION:
Signature on this document provides that the proposer certifies that the following statement and accompanying attachments are true:

1. Substitute product has been fully investigated and determined to be equal or superior in all respects to the specified product performance.
2. Same warranty will be furnished for proposed substitution product as for specified product.
3. Same maintenance service and source of replacement parts, as applicable, is available.
4. Proposed equal product will have no effect on other trades and will not affect or delay progress schedule.
5. Proposed equal product does not affect dimensions and functional performance values.
6. Payment will be made to the Architect for changes to building design, including Architect design, detailing, and construction costs caused by the substitution.
7. The undersigned further states that the function, appearance, and quality of the proposed product are equivalent or superior to the specified item:

Submitted by: _____

Signature: _____

Typed Name: _____

Company: _____

Address: _____

_____ Zip Code: _____

Telephone: _____ Fax: _____

Attachments (List): _____

ARCHITECT REVIEW AND ACTION: (For use of the Architect only)

_____ Proposed product accepted.
_____ Proposed product not in compliance with instructions. Respond to attached comments and resubmit.
_____ Proposed product not acceptable. Use specified product(s).
_____ Not Reviewed. Submission received too late. Use specified product(s).

ADDITIONAL REVIEWER COMMENTS: (For use of the Architect only)

_____

_____

END OF SECTION

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes specific administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:

1. Section 01 25 00 – Substitution Procedures: For administrative procedures for handling requests for substitutions made after Contract award.
2. Section 01 60 00 – Product Requirements for administrative procedures for handling requests for substitutions made after Contract award.

1.02 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on form included in the Project Manual.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Architect's Process: Unless it is mutually agreed to utilize web-based Construction Contract Administration (CCA) software system for tracking and responding to communications between the Architect and the Contractor, documents will be transmitted as PDFs via email or FTP. Documents will be sent as PDF or other standard format (MS Word, Excel, JPEG, etc.) via email or the Architects FTP site.

1. Contractor shall prepare requests and submittals on electronic forms acceptable to Architect and Owner provided the data included is consistent with the Request for Substitution form included at the end of this Section.

1.04 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change..
    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. No lump sum amounts are permitted. Detailed breakdown of costs are required, broken down by labor and materials, etc.; and including prime, subcontractor, sub-subcontractor and/or supplier pricings.
    d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
    e. Use electronic form acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to the Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 25 00 – Substitution Procedures if the proposed change requires substitution of one product or system for product or system specified.
7. Use electronic form acceptable to Architect.

1.05 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Request for Proposal, Architect will issue a Change Order for signatures of Owner and Contractor on form provided by the Owner.

1.06 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on a form acceptable to the Architect. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.
2. To expedite decisions about changes, Contractor is strongly encouraged to use digital photographs or still photographs to transmit information about existing conditions to the Architect’s office.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 26 13

REQUESTS FOR INFORMATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Requests for Information.

B. Related Sections include the following:

1. Drawings and general provisions of the Contract, including General Conditions and Division 01 specification sections, apply to work of this section.

1.02 DEFINITIONS

A. Definitions used in this article are not intended to change or modify the meaning of other terms in the Contract Documents.

B. Request for Information (RFI): A request for information by the Contractor to the Architect for clarification of intent of any portion of the Contract Documents after the award of Contract and during the construction phase of the Project.

C. The following are NOT Requests for Information:

1. Change Orders.
2. Substitution Request.
3. Bulletin.
4. Field Order.
5. Shop Drawings.
6. Normal questions contained in a typical shop drawing submittal.
7. Clarifications during bidding.

1.03 REQUESTS FOR INFORMATION (RFI'S) DURING CONSTRUCTION

A. RFI’s are logged-in at the Architect’s Office, not necessarily with same date as indicated by the Contractor on RFI form. The response time will commence upon the date of receipt by the Architect.

1. Copies of RFI’s sent by the Contractor and received by the Architect after 2:00 p.m. will be considered received the following Monday, holidays excepted at 8:00 a.m. and are to be dated as such.

B. Requests for Information (RFI): If clarification of any portion of Construction Documents is required, submit a Request for Information to the Architect in accordance with the following procedures:

1. RFI Format:

a. Submit on a standard form developed by the Architect.
b. RFI's shall be sequentially numbered; and include the following:

1) Project name.
2) Project number.
3) Date.
4) Name of Construction Manager
5) Name of Contractor.
6) Name of Architect.
7) RFI number, numbered sequentially.
8) RFI subject.
9) Specification Section number and title and related paragraphs, as appropriate.
10) Drawing number and detail references, as appropriate.
11) Field dimensions and conditions, as appropriate.

12) Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
13) Contractor's signature.
14) Adequate space for Architect to respond, sign, and date.
15) Attachments: Include sketches, descriptions, measurements, photos, Product Data, and other information necessary to fully describe items needing information.

a) Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
b) Attachments shall be electronic files in Adobe Acrobat PDF format.

C. Submit a copy of the format to the Architect at start of Project for review and comment.

D. RFI Procedure:

1. Clearly state and completely define the issue requiring information.
2. Each RFI shall address one subject or issue.
1. Each RFI shall contain specific reference to the drawing number(s), detail number(s), schedule type(s), bulletin number(s), specification section(s) and paragraph number(s), or other related document(s) which is (are) pertinent to the Contractor's question. The date of each referenced drawing number, bulletin, specification section, or other related document shall be identified. In preparing each RFI verify the applicable dimension(s), field conditions, drawing requirements (small through large-scale details), and/or specification section requirements pertaining thereto.
2. Prior to submission of an RFI coordinate the nature of the inquiry with the requirements of other sections or trades as related thereto, as well as responses to previous RFI's. Where supplementary sketches are required to clarify an inquiry the Contractor shall attach supplementary sketches, at large scale, illustrative of the inquiry. Sketches shall include sufficient detail, materials, dimensions, thicknesses, assembly, attachments, relation to adjoining work, structural grid references, and all other pertinent data and information for the Architect to make an informed response.

a. The Contractor is encouraged to suggest solution(s) to its inquiries, if applicable.
a. Should the Contractor's solution(s) have an impact on Contract Sum or Contract Time it shall be so stated within the RFI. Provide cost and schedule implications, if any.

3. Ambiguous RFI’s will be returned to Contractor without action taken.

E. RFI Submission Process:

1. Submit an RFI, in writing, to the Architect immediately when any issue requiring clarification arises.

a. Unless specifically stated on RFI, the Architect will assume adjustments to the Contract Amount and the Project Schedule are NOT REQUIRED.

2. The Architect will review and respond only to RFI’s received in writing from the Construction Manager.
3. Submit electronic copies of each RFI and Architect response, including any supplemental drawings and additional instructions, to the Architect for record purposes.
4. RFI’s submitted to the Architect of without following these submission procedures will result in rejection of the submission.

F. RFI Log:

1. Maintain an RFI log indicating the RFI number, subject, date, response date and impact, if any on schedule and cost.
2. Publish the log at least bi-monthly to the Architect.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

1.02 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.03 SCHEDULE OF VALUES

A. Coordinate preparation of Schedule of Values with preparation of Construction Schedule.

1. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:

    a. Application for Payment forms with continuation sheets.
    b. Submittal schedule.
    c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Sub-schedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide sub-schedules showing values correlated with each element.

B. Format and Content: Use the Project Manual table of contents format (specification section numbers and names) to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

    a. Project name and location.
    b. Name of Architect.
    c. Architect's project number.
    d. Contractor's name and address.
    e. Date of submittal.

2. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

        1) Labor.
        2) Materials.
        3) Equipment.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.04 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
    1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
    1. Submit draft copy of Application for Payment seven days prior to due date for review by the Architect.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703, or other form approved by the Owner, as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
    1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
    2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
    3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
    4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
    1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
    2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.

3. Provide summary documentation for stored materials indicating the following:
    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.

I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Combined Contractor’s construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
12. Initial progress report.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.

J. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes administrative provisions for coordinating construction operations within scope of Contractor's work, including, but not limited to, the following:

1. General project coordination procedures.
2. Coordination drawings.
3. Digital Project Management Procedures
4. Project meetings.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Drawings and general provisions of the Contract, including General Conditions and Division 01 specification sections, apply to work of this section.

    a. Section 01 11 00 – Summary of Work.
    b. Section 01 26 13 – Requests for Interpretation (RFI)
    c. Section 01 33 00 – Submittal Procedures: For preparing and submitting Contractor's construction schedule.
    d. Section 01 73 00 – Execution: For procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
    e. Section 01 77 19 – Closeout Requirements: For coordinating closeout of the Contract.

1.02 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner's Representative and sub-contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.

2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Startup and adjustment of systems.
8. Project closeout activities.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.03 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

   a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
   b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
   d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
   e. Indicate required installation sequences.
   f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

   a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:
    a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:
    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.

1.04 KEY PERSONNEL

A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, on Project Web site, and by each temporary telephone. Keep list current at all times.

1.05 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Web-Based Project Software: If web-based Project software is utilized for the purposes of hosting and managing Project communication and documentation for the project, the following applies.
1. Web-based Project software site includes, at a minimum, the following features:
    a. Compilation of Project data, including Construction Manager, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    c. Document workflow planning, allowing customization of workflow between project entities.
    d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    e. Track status of each Project communication in real time, and log time and date when responses are provided.
    f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    g. Processing and tracking of payment applications.
    h. Processing and tracking of contract modifications.
    i. Creating and distributing meeting minutes.
    j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
    k. Management of construction progress photographs.
    l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to ten web-based Project software user licenses for use of Owner's Representative, Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for web-based Project software users.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
4. Provide one of the commercially available web-based Project software packages under their current published licensing agreements:

B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.06 PROJECT MEETINGS AND CONFERENCES

A. General: Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before the start of construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Construction schedule.
b. Phasing.
c. Critical work sequencing and long-lead items.
d. Designation of key personnel and their duties.
e. Procedures for processing field decisions and Change Orders.
f. Procedures for RFIs.
g. Procedures for testing and inspecting.
h. Procedures for processing Applications for Payment.
i. Distribution of the Contract Documents.
j. Submittal procedures.
k. Inspection reports
l. Preparation of record documents.
m. Use of the premises
n. Work restrictions.
o. Working hours.
p. Owner's occupancy requirements.
q. Responsibility for temporary facilities and controls.
r. Procedures for moisture and mold control.
s. Procedures for disruptions and shutdowns.
t. Construction waste management and recycling.
u. Parking availability.
v. Office, work, and storage areas.
w. Equipment deliveries and priorities.
x. First aid.

y. Security.
z. Progress cleaning and final cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes to each party present and to parties requiring information.

C. Progress Meetings: Construction Manager will conduct weekly job progress meeting.

1. Attendees: In addition to representatives of Owner, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Construction Manager's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Construction Manager's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
b. Discuss items of significance that could affect progress, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.
11) Status of correction of deficient items
12) Field observations
13) Status of RFI's
14) Status of proposal requests.
15) Pending changes.
16) Status of Change Orders.
17) Pending claims and disputes.
18) Documentation of information for payment requests.

3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

D. Pre-installation Conferences: Conduct a pre-installation conference at the site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFI's
d. Related Change Orders.

e. Purchases
f. Deliveries.
g. Shop Drawings, Product Data and quality control Samples.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility problems.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Inspection and testing requirements.
u. Installation procedures.
v. Required performance results.
w. Recording requirements.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. General Contractor: Record significant discussions and agreements and disagreements of each conference, along with the approved schedule. Promptly distribute meeting records to everyone concerned, including the Owner and Architect.
4. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.02 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

1. Product Data
2. Shop Drawings
3. Samples
4. Product Schedules
5. Submittal Schedule
6. Applications for Payment
7. Schedule of Values
8. Subcontract List

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as informational submittals and may include the following:

1. Preconstruction Submittals.
2. Schedules.
3. Certificates and certifications.
4. Special warranty forms.
5. Test and inspection reports.
6. Construction photographs.
7. Meeting minutes.
8. Coordination drawings.

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.03 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with start-up construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Construction Manager's construction schedule.

    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal category: Action, informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled dates for installation.
    i. Activity or event number.

1.04 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic copies of digital data files the Contract Drawings will be provided by Architect for Construction Manager's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Construction Manager when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 21 days for review of each submittal. Submittal will be returned to Construction Manager, through Architect, before being returned to Contractor.

1.05 ELECTRONIC SUBMITTAL PROCEDURES

A. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Transmittal Form for Electronic Submittals: Use electronic form provided by the Construction Manager.

B. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
2. Electronic submittals shall be submitted as PDF files directly to the Construction Manager. Refer to Special Conditions #10 Electronic Requirements Prolog Converge, and RFI's. Construction Manager shall review submittal and notify Architect via email when submittals are posted to the web site and ready to be reviewed.
3. All submittals are to be submitted electronically except for samples, color charts, and mockups.
4. Include the following information on an inserted cover sheet:

    a. Project name.
    b. Date.
    c. Name and address of Architect.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Name of firm or entity that prepared submittal.
    g. Name of subcontractor.
    h. Name of supplier.
    i. Name of manufacturer.
    j. Number and title of appropriate Specification Section.
    k. Drawing number and detail references, as appropriate.
    l. Location(s) where product is to be installed, as appropriate.
    m. Related physical samples submitted directly.
    n. Other necessary identification.

5. Include the following information as keywords in the electronic file metadata:

    a. Project name.
    b. Number and title of appropriate Specification Section.
    c. Manufacturer name.
    d. Product name.

C. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor. Retain subparagraph above or first subparagraph below. Retain below if transmittal forms typically used by contractors are acceptable; otherwise, retain above. Above is more common.

1. Transmittal Form: Provide locations on form for the following information:

    a. Project name.
    b. Date.
    c. Destination (To:).
    d. Source (From:).
    e. Contractor's signed approval.
    f. Names of subcontractor, manufacturer, and supplier.
    g. Category and type of submittal.
    h. Submittal purpose and description.
    i. Specification Section number and title.
    j. Indication of full or partial submittal.
    k. Drawing number and detail references, as appropriate.
    l. Transmittal number.
    m. Submittal and transmittal distribution record.
    n. Remarks.
    o. Signature of transmitter.

2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.

2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp

PART 2 – PRODUCTS

2.01 SUBMITTAL PROCEDURES

A. Coordinate preparation and processing of submittals with performance of construction activities. To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for resubmittals. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.

B. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

C. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination. The Architect will withhold action on a submittal requiring coordination with other submittals until all related submittals are received. No extension of Contract Time will be authorized because of failure to transmit submittals to the Construction Manager/ Architect sufficiently in advance of the Work to permit processing.

D. Prepare each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the Construction Manger using the established transmittal form. The Architect will not accept submittals received from sources other than the Contractor.

E. Each submittal shall include one (1) electronic Submittal Cover Sheet. The Submittal Cover Sheet does not replace the required use of transmittals. The Construction Manager will furnish each Contractor an electronic file of the required Submittal Cover Sheet. All submittals including product data and certifications, color charts, shop drawings, samples, and mock-ups each require a Submittal Cover Sheet.

1. The following will be included on the Submittal Cover Sheet provided by the Construction Manager: Contractor’s name and Project title, the Contractor’s and Architect’s submittal stamps.
2. The Contractor shall electronically enter the following on the Submittal Cover Sheet:

    a. Project name
    b. Date
    c. Submittal Number. Submittals are to be numbered consecutively. The Construction Manager will provide numbering instruction at the time the electronic file is forwarded to the contractor. If re-submittals are necessary, the original submittal number is used along with the suffix R1, R2, etc.
    d. Name of Contractor/ Subcontractor/ Supplier
    e. Name of firm or entity that prepared submittal.
    f. Category and type of submittal.
    g. Specification section number and title.
    h. Specification section, article and paragraph reference; Drawing reference number and detail references, as appropriate.
    i. Item(s) Submitted. Provide specific information. (Example: Product data for all plumbing fixtures with the exception of fixture supports).
    j. Location(s) where product is to be installed, as appropriate.
    k. Indication of full or partial submittal.
    l. Additional Information or Proposed Deviation: The Contractor is required to specifically identify a proposed deviation contained in a submittal. (Example: Scheduled product is discontinued. Product submitted is the current model #.)
    m. Other necessary identification.

F. Additional requirements for submittals are:

1. The Contractors markings on the submittals shall be made in the color green. This does not apply to information on the cover sheet.
2. Submittals that are marked by the Architect as “Not Approved” or “Revise and Resubmit” will be returned to the Contractor. Revise and resubmit submittals as required; identify all changes made since previous submittal.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
4. In addition to the above, clearly indicate the following:

    a. Relation to adjacent structure or materials.
    b. Field dimensions, clearly identified as such.
    c. Product or material conformance with applicable standards, such as ASTM standard or Federal Specification.

5. Allow fourteen (14) working days for review by the Architect. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

G. Transmit under a separate cover sheet each material, product, equipment or assembly required in a specification section. Submittals grouping two or more types of unrelated systems or assemblies or submittals from more than a single specification section will not be reviewed and will be returned to the Contractor. Sequentially number the transmittal forms. Re-submittals to have original number with an alphabetic suffix.

H. Apply Contractor's stamp, signed or initialed, certifying that review, verification of products required, field dimensions, adjacent construction Work, and coordination of information are in accordance with the requirements of the Contract Documents.

I. Schedule submittals to expedite the Project and deliver to Architect at business address. Coordinate submission of related items.

J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

K. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

2.02 PRODUCT DATA

A. Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the work.

1. The data shall be supported by sufficient descriptive material, such as catalog cuts, diagrams, and other data published by the manufacturer, as well as by evidence of compliance with performance standards, to demonstrate conformance to the Specification requirements.
2. Catalog numbers alone are not acceptable.
3. The data shall include, but shall not be limited to, the name and address of the nearest service and maintenance organization that regularly stocks repair parts. No consideration shall be given to partial lists submitted unless otherwise noted.
4. Review of materials and equipment is tentative, subject to submission of complete shop drawings indicating compliance with the Contract Documents.
5. Cross out information which is not applicable to the work.
6. Supplement standard information to provide additional information which is applicable to the work.
7. Show dimensions and clearances required.
8. Show performance characteristics and capacities.

B. Collect product data into a single submittal for each element of construction or system. Product data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where product data must be specially prepared because standard printed data is not suitable for use, submit as "shop drawings". Do not submit product data until compliance with requirements of the Contract Documents has been confirmed.

C. Mark each copy to show which products and options are applicable. Where printed product data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information as applicable:

1. Manufacturer's catalog cuts
2. Manufacturer's product specifications
3. Standard color charts
4. Statement of compliance with specified referenced standards.
5. Testing by recognized testing agency.
6. Application of testing agency labels and seals.
7. Availability and delivery time information.
8. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams showing factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

D. Do not proceed with installation until a copy of product data is in the Installer’s possession.

E. Submit Product Data before or concurrent with Samples.

F. Submit Product Data in PDF electronic file format.

2.03 SHOP DRAWINGS

A. Shop Drawings: Project-specific drawings, diagrams, schedules, and other data specially prepared for the work by the Contractor or a subcontractor, sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the work, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

B. Shop drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:

1. Identification of products and materials included by sheet and detail number.
2. Dimensions.
3. Compliance with specified standards.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.
6. Relationship and attachment to adjoining construction clearly indicated.
7. Seal and signature of professional engineer if specified.

C. Wiring Diagrams: Accompany shop drawings with specific wiring diagrams and instructions on equipment controls or devices which are to be furnished. The diagrams and instructions shall not be of a general nature, but shall be modified to be specific to this Project. Include identical diagrams and instructions for the installation of the equipment and identical diagrams in the operation and maintenance manuals. Wiring diagrams shall indicate interconnection between pieces of electrical equipment.

D. Coordination drawings are a special type of shop drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.

1. Preparation of coordination drawings is specified in Section 01 31 00 – Project Management and Coordination, and may include components previously shown in detail on shop drawings or product data.

E. After review, reproduce and distribute in accordance with “Submittal Procedures” above.

F. Submit shop drawings in PDF electronic file format.

2.04 SAMPLES

A. Submit the required number of physical samples required, the Architect will retain a minimum of two (2) physical Samples, remainder will be returned unless otherwise provided. Cure and finish samples as specified and physically identical with the material or product proposed.

B. Samples may include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing colors, texture and pattern. Illustrate functional and aesthetic characteristics of materials, equipment, or workmanship, with integral parts and attachment devices. Coordinate sample submittals for interfacing Work.

C. Mount, display, or package samples in the manner to facilitate review of quantities indicated. Prepare samples to match the Architect's sample. Include the following information attached with label on unexposed side of Samples and include the following:

1. Generic description of the sample.
2. Specification section number and paragraph number reference.
3. Sample source.
4. Product name or name of manufacturer.
5. Compliance with recognized standards.
6. Availability and delivery time.

D. Submit samples for review of size, kind, color, pattern, and texture, for a final check of these characteristics with other elements, and a comparison of these characteristics between the final submittal and the actual component as delivered and installed. Where finishes are not indicated as custom, provide full range of manufacturers' standard finishes.

E. Where variation in color, pattern, texture or other characteristic is inherent in the material or product represented, submit at least 3 multiple units that show approximate limits of the variations.

F. Refer to other Specification sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.

G. Reviewed samples which may be used in the Work are indicated in individual specification sections.

H. Provide corresponding electronic submittal of sample transmittal, digital image file illustrating sample characteristics, and identification information for record.

I. Disposition: Maintain sets of approved samples at Project site, available for quality- control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

J. The Contractor shall furnish additional certification of conformance to the specification requirements as may be requested by the Architect.

2.05 SCHEDULE OF VALUES

A. Coordinate preparation of the schedule of values with the progress schedule.

B. Correlate line items in the schedule of values with other required administrative schedules and forms, including:

1. Contractor's Construction Schedule.
2. Application for payment form.
3. List of subcontractors.
4. Schedule of alternates.
5. List of products.
6. Schedule of submittals.

C. Submit the schedule of values to the Construction Manager at the earliest feasible date, but in no case later than thirty (30) days after receipt of the Subcontractor Agreement.

D. Use the Project Manual Table of Contents as a guide to establish the format for the schedule of values. Include the following Project identification on the schedule of values:

1. Title of project and location.
2. Construction Manager
3. Name of the Architect.
4. Project number.
5. Contractor's name and address.
6. Date of submittal.

E. Arrange the schedule of values in a tabular form with separate columns to indicate the following for each item listed:

1. Generic name.
2. Related specification section.
3. Change Orders (numbers) that have affected value.
4. Dollar value.
5. Percentage of Contract Sum to the nearest one-hundredth percent, adjusted to total 100 percent.

F. Provide a breakdown of the Contact Sum in sufficient detail to facilitate continued evaluation of applications for payment and progress reports. Break principal subcontract amounts down into several line items. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.

G. For each part of the work where an application for payment may include materials or equipment purchased or fabricated and stored, but not yet installed, provide separated line items on the schedule of values for initial cost of the materials for each subsequent stage of completion and for total installed value of that part of the work.

H. Show line items for indirect costs and margins on actual costs only to the extent that such items will be listed individually in applications for payment. Each item on the schedule of values and applications for payment shall be complete including its total cost and proportionate share of the general overhead and profit margin.

I. Update and resubmit the Schedule of Values when Change Orders or construction change directives result to a change in the Contract Sum.

2.06 QUALITY ASSURANCE SUBMITTALS

A. General: Submittals that are not listed as submittals for review are quality control submittals. Quality control submittals are submitted for information only and include design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other sections of the specifications.

B. Where other sections of the Specifications require certification that a product, materials, or installation complies with specified requirements, submit a notarized certifications from the manufacturer certifying compliance with specified requirements.

1. Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.

C. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 –Project Management and Coordination.

D. Construction Manager's Construction Schedule: Comply with requirements specified in Section 01 32 00 - Construction Progress Documentation.

E. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 45 00 – Quality Control.

F. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 – Closeout PRocedures.

G. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

H. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

I. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

J. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

K. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

L. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

M. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

N. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

O. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

P. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

Q. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

R. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.07 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

2.08 SUBMITTAL TYPES

A. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

B. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

C. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

D. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

E. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

F. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

G. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

H. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

I. Maintenance Data: Comply with requirements specified.

2.09 QUALITY ASSURANCE

A. Perform no Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals or order products or materials until the Shop Drawings, Product Data, Samples or similar submittals have been submitted to and approved by the Architect. Work started on products or materials, or fabrication before final approval of the Shop Drawings, Product Data, Samples or other similar submittal by the Architect, shall be under risk that no payment will be made for non-approved Work or product or material and the non-approved Work, product or material will be rejected.

PART 3 – EXECUTION

3.01 CONTRACTOR RESPONSIBILITIES

A. Submittals of shop drawings, product literature or data, samples, etc., shall be made for complete assemblies or units of the Work. Submittals which represent only a portion of a part of a larger assembly or unit of work is not acceptable and will be rejected by the Architect.

B. Check shop drawings, project data and samples prior to submission. Shop drawings not indicating evidence of checking by Contractor will be returned without review by the Architect. No time extensions will be permitted for this type of resubmittal.

C. All submittals must bear a stamp indicating that the Contractor and Construction Manager have reviewed the submittal prior to forwarding to the Architect, or they will be returned to the Contractor without action.

D. Coordinate each submittal with requirements of the Work and of Contract Documents.

E. The Contractor shall not be relieved of responsibility for errors or omissions in shop drawings, product data, samples or similar submittals by Architect's approval thereof.

F. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of shop drawings, product data, samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and the Architect has given written approval to the specific deviation.

G. Notify Architect, in writing at time of submission, of deviations in submittals from requirements of Contract Documents.

H. Begin no work which requires submittals until return of submittals with Architect's stamp and initials or signature indicating review.

I. Materials or equipment installed prior to the required shop drawing, product data, or sample approval shall be subject to removal and replacement by the Contractor at no additional cost to the Owner, if in the opinion of the Architect, such materials or equipment do not meet the requirements of the Contract Documents.

J. No xerographic or altered xerographic reproductions of the Contract Documents are permitted as submittals. Facsimiles or copies of facsimiles are not acceptable as required submittals to be furnished under this section.

3.02 ARCHITECT'S AND CONSTRUCTION MANAGER'S ACTIONS

A. Action Submittals: Architect and Construction Manager will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. Approved
2. Approved as Noted
3. Revise and Resubmit.
4. Not Approved
5. Reviewed
6. Not Reviewed

B. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.

C. Review of submittals is not for the purpose of determining the accuracy or completeness of details, dimensions, or quantities, or for substantiating instructions for installation or performance of equipment or systems.

D. Architect's review is not for approval of safety precautions or of construction means, methods, techniques, sequences, or procedures.

E. Approval of a specific item shall not indicate approval of an assembly of which the item is a component.

F. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.

G. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

H. Submittals not required by the Contract Documents may be returned by the Architect without action.

3.03 PROPOSED PRODUCT/MATERIALS SCHEDULE

A. Within 30 days of receipt of the Subcontract Agreement, submit schedule of products/materials proposed for use. Prepare schedule in tabular form showing each product proposed for use in the Work. Include the manufacturer's name and proprietary product/material names for each item listed.

1. Coordinate the product list with the list of proposed materials manufacturers.
2. Prepare the product schedule with information on each item tabulated under the following column headings:

    a. Related specifications section number.
    b. Generic name used in Contract Documents.
    c. Proprietary name, model number and similar designations.
    d. Manufacturer's name and address.
    e. Supplier's name and address.
    f. Installer's name and address.
    g. Projected delivery date or time span of delivery period.

3. Provide a written explanation for omissions of data and for known variations from Contract requirements.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation and reference standards.

C. Submit proposed Product Schedule in PDF electronic file format.

END OF SECTION

SECTION 01 42 00

REFERENCE STANDARDS AND DEFINITIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes general definitions for Specifications and other Contract Documents. Basic contract definitions are included in the Conditions of the Contract.

B. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

C. Comply with standards in effect as of date of the Contract Documents except comply with standards having different revision dates as referenced in the codes as indicated on Drawings.

1.02 QUALITY ASSURANCE

A. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

1.03 GENERAL DEFINITIONS

A. General Explanation: Basic Contract definitions are included in the Construction Agreement of the Contract. Certain terms used in Contract Documents are defined generally in this article. Definitions and explanations that follow are not necessarily either complete or exclusive, but are general for the Work to the extent they are not stated more explicitly in other provisions of the Contract Documents.

B. Approved: The term "approved" where used in conjunction with Architect's action on the Contractor's submittals, requests, and applications, is limited to the Architect's duties and responsibilities as specified in the Conditions of the Contract. In no case will "approval" by Architect be interpreted as a release of Contractor from responsibilities to fulfill requirements of Contract Documents.

C. Contract Completion: The date upon which all deficiencies noted in the “punch list” have been corrected, the Contractor’s work is 100 percent complete, and the Contractor has complied with all conditions precedent to final payment and release of retainage.

D. The term "Contractor" shall be understood to mean Construction Manager who holds the trade contracts.

E. Cutting and Patching: The term "cutting and patching" means cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.

1. Cutting and patching is performed for coordination of the Work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.
2. Cutting and patching performed during the manufacturer of products, or during the initial fabrication, erection or installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners and similar operations are also not considered to be "cutting and patching."

F. Demolish: The term "demolish" shall mean to wreck or destroy a structure or building system assembly (such as floor or ceiling system, walls or partitions, etc.) and the removal of wrecked materials from the job site. Where new work is not specified for the adjoining surface, selective demolition shall require " cutting and patching" wherever demolished portions of a structure adjoin portions to remain.

G. Directed, Requested, etc.: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by Architect" "requested by Architect" and similar phrases. However, no such implied meaning shall be interpreted to extend Architect's responsibility to Contractor's area of construction supervision.

H. "Existing to Remain" or "Retain": Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled.

I. Experienced: When used with an entity or individual, 'experienced' means having successfully completed a minimum number of projects similar in nature, size, and extent to this Project; and having a number of years of experience (as defined in the specification section) being familiar with special requirements indicated; and having complied with requirements of building code officials and industry standards.

J. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.

K. Indicated: The term "Indicated" is a cross-reference to graphic representations, notes, or schedules on the Drawings or other paragraphs or Schedules in the Specifications, and to similar requirements in Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.

L. Install: Except as otherwise defined in greater detail, the term "install" describes operations at Project Site including the actual unloading, temporary storage, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.

M. Installer: An Installer is the Contractor or an entity (person or firm) engaged by the Contractor, either as an employee, subcontractor or contractor of lower tier, to perform a particular construction activity, including installation, erection, application and similar required operations. Installers are required to be experienced in the operations they are engaged to perform.

1. Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.

N. ORC: The Ohio Revised Code.

O. Project Site: The project site Is the space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing either work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land upon which the Project is to be built.

P. Protect: The term "protect" shall mean to cover, enclose, shield or take other designated measures to avoid damage or harm. Items protected will either remain in place, or will be salvaged for re-installation in the Work. The type of protection shall be as specified. Where the type of protection is not specified, items shall be protected from any and all damage, scratches, marking, overspray, dripping, deterioration, or movement from any and all activities scheduled to take place on this Project, and/or would be typical to a Project site such as this one.

Q. Provide: Except as otherwise defined in greater detail, the term "provide" means to furnish and install, complete and ready for the intended use.

R. Re-install: The term "re-install" or "re-installation" shall mean to install a salvaged or stored item or material in the Work.

S. Remove: The term "remove" shall mean to detach or separate an item, component or assembly from its installed location, and dispose of off-site, unless indicated to be removed and salvaged or removed and reinstalled . Removal shall be accomplished without damage to adjacent materials, components or systems that are to remain. Damage that must be incurred during removal shall be repaired as cutting and patching.

T. Repair:

1. The term "repair" shall be defined as “Replacement of component(s), either damaged or missing, which are part of a larger assembly, to return an existing material as closely as possible to its original form, structural integrity and condition.” Generally, the types of work required to achieve a “repaired” condition are the following:

a. Disassembly of existing components or construction for the purpose if installing new components.

b. Removal of the component or portion of an assembly designated for repair.
c. Preparation of the adjacent surfaces to receive the repair.
d. Installation and securing the repaired component in the assembly.
e. Preparation of the assembly to receive a finish as specified in the finishing or painting specification.

U. Replace: To duplicate and replace entire features with new material in kind. Replacement includes the following conditions:

1. The term "replace" shall be defined as providing in a former position or place.
2. The term may be combined with such terms as “with existing” or “with new” which define exactly what is to be replaced.

a. Duplication: Includes replacing elements damaged beyond repair or missing. Original material is indicated as the pattern for creating new duplicated elements.
b. Replacement with New Materials: Includes replacement with new material when original material is not available as patterns for creating new duplicated elements.

3. Reference individual specification sections for further definition of “replace” as it relates to a specific application or condition.

V. Restore:

1. The term "restore" shall be defined as a general term for the process of returning a material, component, system or portion of work as nearly as possible to its original form or condition when it was new.
2. The term "restore" when used in a general sense may include the process of ‘repair’ defined above.
3. Refer to individual specification sections for further definition of “restore” as it relates to a specific application or condition.
4. Generally , the process involved with “restore” or “restoration” include the following:

a. Removal of applied items or materials which are not to be part of the restored work.
b. Stripping or other types of removal of surface applied coatings (i.e., paint).
c. Modifying the material if it is required to accommodate new work.
d. Replacement of <u>portions</u> of components or materials that cannot be restored because of condition, including those that are deteriorated or otherwise damaged. Replacement is typically done with dutchmen.
e. Reinforcing broken components when this procedure is acceptable in lieu of “repair.”
f. Tightening and securing open or loose joints.
g. Patching or plugging holes or other severe loss of the existing material.
h. Filling of minor holes, scratches, dents, or other deformation not associated with normal wear and tear.
i. Sanding of the repaired surfaces smooth as a result of the restore process, prior to final surface preparation for finishing.

5. Minor surface preparation of a reconditioned surface prior to other finishing or painting is <u>not</u> considered part of the “restore” process, and is specified as preparation in the finishing or painting specification.
6. It is not the intent of the “restore” process to return a material that shows normal wear to an original “like new” appearance or condition. Rather, such wear is considered a normal part of the use and life of the particular material, and as such does not require “restoring”

W. Regulations: The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

X. Salvage: The term "salvage" shall mean the removal of items, components, equipment or materials from their installed location, and protection and storage of such items, components, equipment or materials. Salvaged items will be designated either to be re-installed in the Work, stored, or turned over to the Owner or other designated entity, plus such other work as described.

Y. Store: The term "store" shall mean to protect and place in a designated area. Where an area is not designated, the Contractor responsible for the item shall provide adequate and reasonable facilities acceptable to the Architect.

Z. Testing Agencies: A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.04 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. The Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 2020 MASTERFORMAT numbering system.

B. This Specification uses certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

1. Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated, shall be interpolated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicate.
2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.
3. The words "shall be" are implied where a colon (:) is used within a sentence or phrase.

1.05 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1. Referenced standards (referenced directly in Contract Documents or by governing regulations) have precedence over non-referenced standards which are recognized in industry for applicability to Work.
2. Publication Dates: Comply with standard in effect as of the date of the Contract Documents, unless otherwise indicated.
3. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed to perform a required construction activity, obtain copies directly from the publication source.
4. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authority having jurisdiction, or other entity applicable to the content of the text provision.

1.06 GOVERNING REGULATIONS AND AUTHORITIES

A. The Architect has contacted authorities having jurisdiction where necessary to obtain information to prepare Contract Documents. Contact authorities having jurisdiction directly for information and decisions regarding the Work.

B. For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts of fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes administrative and procedural requirements for quality assurance and quality-control services.

B. Quality control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by the Architect.

C. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contraction Manager's quality-assurance and control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Construction Manager to provide quality-assurance and control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

D. Related Documents/ Sections:

1. Drawings and general provisions of the Contract, including General Conditions and Division 01 specification sections, apply to work of this section.

    a. General Conditions: (Tests), inspections, testing, and approvals.

2. Section 01 32 00 – Construction Progress Documentation: For developing a schedule of required tests and inspections.
3. Section 01 33 00 – Submittal Procedures: Submission of manufacturers' instructions and certificates.

1.02 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.

1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Construction Manager or another entity engaged by Construction Manager as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.03 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.04 SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

B. Construction Manager's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

C. Construction Manager's Quality-Control Manager Qualifications: For supervisory personnel.

D. Construction Manager's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.

1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the Architect.
2. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the Architect.

E. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

F. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.

6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

G. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities:

H. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

I. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.05 CONSTRUCTION MANAGER'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to proceed and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Construction Manager's quality-assurance and quality-control responsibilities. Coordinate with construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Construction Manager-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Construction Manager-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated in “Statement of Special Inspections.”
3. Owner-performed tests and inspections indicated in the Contract Documents.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.06 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

C. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

F. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

G. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

H. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

   1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.

I. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

   1. Contractor responsibilities include the following:

      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
      d. When testing is complete, obtain approvals to remove test specimens, assemblies, and mockups; do not reuse products on Project.

   2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.07 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Construction Manager with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Construction Manager, and the Contract Sum will be adjusted by Change Order.

B. Construction Manager Responsibilities: Tests and inspections not explicitly assigned to the Owner are Construction Manager's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Construction Manager by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Construction Manager's or Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    a. Construction Manager and Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Construction Manger's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Construction Manager and not required by the Contract Documents are Construction Manager’s responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Price will be adjusted by Change Order.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

F. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.

G. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

H. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspecting equipment at Project site.

I. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

J. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of the Construction Manager's quality-control plan. Coordinate and submit concurrently with Construction Manager's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.08 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Construction Manager promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Construction Manager, Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

1.09 MOCK-UPS

A. Refer to Section 01 43 30 – Mockups.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.02 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for Section 01 73 00 – Execution.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Construction Manager's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities. Provide construction facilities and temporary utilities as shown and specified.

B. Related Sections:

1. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
2. Section 01 11 00 – Summary of Contracts: General requirements and description of project and procedures.

1.02 DEFINITIONS

A. "Maintain" shall mean to keep in service and operation; and to provide such repairs as required to keep in continued service and safe, sound condition until and only if directed by the Architect to be removed.

1.03 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

B. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.04 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations.

D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste handling procedures.
5. Other dust-control measures.

1.05 DESCRIPTION OF REQUIREMENTS

A. Provide all materials, labor and related items necessary to complete the Work indicated on the drawings and specified.

B. Definitions: Specific administrative and procedural minimum actions are specified in this section, as extensions of provisions in General Conditions and other Contract Documents. These requirements have been included for special purposes as indicated. Nothing in this section is intended to limit types and amounts of temporary Work required, and no omission from this section will be recognized as an indication by Architect that such temporary activity is not required for successful completion of the Work and compliance with requirements of Contract Documents.

C. Provisions of this section are applicable to, but not by way of limitation, utility services, construction facilities, security/protection provisions and support facilities.

D. Provide and maintain temporary construction facilities and control as specified herein and as required for the progress and completion of the Work. Terminate and remove when no longer required for proper performance of the Work, or when permanent facilities are available for use.

E. Provide, maintain, and protect temporary construction facilities and controls as specified herein in a manner which does not interfere with the permanent construction; which is safe, non-hazardous, sanitary, and which adequately protects the public, workmen, and the Work.

F. Provide materials and equipment adequate in capacity for the intended use, which will not create unsafe conditions, and that conform to applicable codes and standards.

G. Contractors requiring one of the temporary services or controls before it can be provided shall provide such service as suits Contractor's needs at Contractor's own expense.

1.06 QUALITY ASSURANCE

A. Comply with industry standards and applicable laws and regulation of authorities having jurisdiction including, but not limited to, the following:

1. Building code requirements.
2. Environmental protection regulations.
3. Health and safety regulations.
4. Utility company regulations.
5. Police and fire department rules.

B. Comply with the following standards:

1. NFPA 241 “Standard for Safeguarding Construction, Alterations, and Demolition Operations.”
2. ANSI A10 Series standards for “Safety Requirements for Construction and Demolition,” and ANSI A10.6, NECA's "Temporary Electrical Facilities."
3. Comply with NEMA, NECA, and UL standards and regulation for temporary electrical service. Install service in compliance with NFPA 70 “National Electrical Code.”

C. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.

1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.

D. Protect, stairs, ramps, walks, and other wearing surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials as specified in this section and illustrated on the drawings.

E. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

F. Install, operate, maintain and protect temporary facilities in a manner and a location which will be safe, non-hazardous, sanitary and protective of persons and property and free of deleterious effects.

G. Protect work against damage and maintain work, materials, apparatus and fixtures free from injury or damage in accordance with the General and Special Conditions during the entire construction period. Protect installed work and provide special protection where specified in individual specification sections. Work likely to be damaged shall be covered or protected at the end of each day's work. Work damaged by fail-

ure to provide protection required, shall be removed and replaced with new work at the Contractor's expense.

H. The Owner will provide for the security of the existing building during periods when work is not being performed, and at times when the building is exposed to the exterior. Coordinate access barrier locations within the existing buildings which can be secured with a lock to prohibit access during these periods.

I. Protect existing finished floors, stairs, and other wearing surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials as specified in this section and as noted on the drawings.

1.07 PROJECT CONDITIONS

A. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:

1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the Work.
3. Temporary facilities and controls shall be removed by the designated Contractor responsible for the temporary facility and/or controls upon completion of the work, unless otherwise indicated.

B. Prepare a schedule indication dates for implementation and termination of each temporary facility. Establish and initiate use of each temporary facility at time first reasonably required for proper performance of the Work. Terminate use and remove facilities at earliest reasonable time, when no longer needed or when permanent facilities have, with authorized use, replaced the need.

C. Operate temporary facilities in a safe and efficient manner. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Provide new temporary materials. If acceptable to the Architect, Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for intended use.

B. Lumber, General: Comply with DOC PS 20, “American Softwood Lumber Standard,” and with applicable grading rules of inspection agencies certified by ALSC’s Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed seasoned lumber, S4S, unless otherwise indicated.
4. Provide kiln-dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
5. Grade: Construction or No. 2 grade
6. Species:

    a. Douglas fir-larch; WCLIB or WWPA.
    b. Douglas fir-larch (north); NLGA.
    c. Hem-fir; WCLIB or WWPA.
    d. Hem-fir (north); NLGA.
    e. Spruce-pine-fir (south); NELMA, WCLIB, or WWPA.
    f. Spruce-pine-fir; NLGA.

C. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of 15 or less. For temporary weather protection and other uses, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.

D. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

E. Fasteners: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacturer.

1. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers.
2. Lag Bolts: ASME B18.2.1.
3. Wood Screws: ASME B18.6.1.
4. Nails, Wire, Brads and Staples: FS FF-N-105.

2.02 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.03 EQUIPMENT

A. General: Provide equipment suitable for use intended.

B. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

C. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.02 TEMPORARY WATER FOR CONSTRUCTION USE

A. Water is available at the existing building. Connect to Owner's existing water service facilities. Consumption charges are to be paid by the Owner.

B. Furnish the necessary hoses, nozzles, connectors, accessories and temporary extensions to properly service his own requirements, and be responsible for damage resulting from his careless use of water.

3.03 TEMPORARY ELECTRIC AND LIGHTING

A. The Owner will pay all electrical consumption charges associated with electrical services.

B. Furnish the necessary extension cords for temporary electric and lighting to properly service the Contractor’s requirements. Contractors shall be responsible for the proper use and maintenance of their cord sets and cord-and-plug connected equipment. Do not fasten to floor or wall finishes.

C. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, and inspections.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.04 TEMPORARY HEATING AND COOLING

A. Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

B. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

3.05 TEMPORARY SANITARY FACILITIES

A. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

B. Permanent toilet facilities in the existing building shall not be used by construction personnel.

3.06 DEWATERING FACILITIES

A. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Extract and dispose of groundwater and rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

3.07 PROTECTION OF WORK AND PROPERTY

A. The Contractor shall protect his own work and existing or adjacent property against weather, to maintain their work, materials, apparatus and fixtures free from injury or damage in accordance with the General Conditions during the entire construction period. Work likely to be damaged shall be covered or protected at the end of each day's work. Work damaged by failure to provide protection required, shall be removed and replace with new work at the Contractor's expense.

B. Protect installed Work and provide special protection where specified in individual specification Sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.

D. Utility Protection:

1. Existing utility lines and structures indicated or known, and utility lines constructed for this Project shall be protected from damage during construction operations by the Contractor.
2. Locate and flag lines and structures before beginning excavation and other construction operations.
3. When utility lines and structures that are to be removed or relocated are encountered within the area of operations, notify the affected utility in ample time for the necessary measures to be taken to prevent interruption of the services.
4. Damage to existing utility lines or structures not indicated or known shall be reported immediately to the affected utility.

3.08 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise or vibration.

C. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent."

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

F. Barricades: Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic, barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

G. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

J. Site Enclosure Fence: Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

K. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

3.09 MOISTURE AND MOLD CONTROL

A. Constriction Manager's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

C. Partially Exposed Construction Phase: After opening and exposure of building interior, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.
6. Do not load or install gypsum board or other porous materials or components, or items with high organic content, into partially enclosed building.
7. Keep interior spaces reasonably clean and protected from water damage.
8. Periodically collect and remove waste containing cellulose or other organic matter.
9. Do not install material that is wet.
10. Discard or replace water-damaged material.
11. Discard, replace, or clean stored or installed material that begins to grow mold.
12. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.10 TEMPORARY BARRIERS

A. Provide fencing along the construction site at all open excavations and tunnels to control access by unauthorized people.

B. Prior to the start of construction, provide temporary construction barricades, to separate construction activities from the public for safety and liability protection. Locations to be subject to Construction Manager’s approval and will vary from time to time as construction progress and need dictates. Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against.

3.11 TEMPORARY INTERIOR PARTITIONS

A. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
2. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
3. Provide walk-off mats at each entrance through temporary partition.

3.12 MAINTENANCE OF TRAFFIC

A. Coordinate traffic control with the Construction Manager for City of Columbus requirements and conditions and State and Local Regulations.

B. Conduct operations in a manner that will not close adjacent street or interfere in any way with traffic on streets except with written permission of the Construction Manager at least 15 calendar days prior to the proposed modification date. Provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval of the City. The plan must be in accordance with State and local regulations. Make all notifications and obtain any permits required for modification to traffic movements.

C. Conduct work so as to minimize temporary obstruction of traffic, and maintain traffic on the roadway width at all times. Obtain approval from the Construction Manager prior to starting any activity that will obstruct traffic in accordance with the approved Traffic Control Plan.

3.13 CONSTRUCTION AIDS

A. Architect's access to the Work: Facilitate access for the Architect and Construction Manager examination of all portions of the Work while in progress, and during closeout phase of the work. The Architect will communicate the dates of site visits near the completion of the work. The Contractor shall either maintain such cranes, hoists, ladders, scaffold towers, swing stages, and planking for areas of the work requiring inspection, or shall provide and operate such equipment at the time of notice of such an inspection. Such equipment shall remain available until notified by the Architect.

B. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

1. Do not load elevators beyond their rated weight capacity.
2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

C. Provide construction aids necessary for proper and efficient movement of materials, and operating personnel as required for the performance of the Work by all trades. Such apparatus and equipment shall meet requirements of labor laws, federal safety regulations, and other applicable codes, laws, and regulations of authorities having jurisdiction.

D. Protect permanent construction from damage, staining, or marring due to use of hoists, scaffolds, staging, etc. Do not free-drop materials, rubbish or debris.

E. Provide temporary cranes, hoists, chutes, scaffold and scaffold towers, swing stages, planking, ladders, and similar items necessary for proper and efficient movement of materials, and operating personnel as required for the performance of the Work by all trades. Such apparatus and equipment shall meet requirements of labor laws, federal safety regulations, and other applicable codes, laws, and regulations of authorities having jurisdiction.

F. Shoring and Bracing: Provide, erect, and maintain adequate shoring and bracing required for public and project safety and proper execution of the work. . Each Contractor shall shore and brace the structure as required to accomplish their work.

3.14 DEBRIS REMOVAL

A. Daily cleanup of the Contractor's debris is mandatory for this project and is to be included in the Contract. Contractor is responsible to properly transport general debris to the dumpster or trash container locations and compaction of debris into said containers in a manner that allows containers to be fully utilized. Materials not removed by the Contractor or improperly stored, will be discarded, as directed by the Architect, at the delinquent Contractor's expense, including replacement of material, if required.

B. Materials not removed by the Contractor or improperly stored, will be discarded, as directed by the Architect, at the delinquent Contractor's expense, including replacement of material, if required.

3.15 DUMPSTERS

A. Provide dumpsters as required to service the project. Contractors failing to load dumpsters properly and/or failing to break down cartons, ductwork, etc. will be charged for removal of partially filled dumpsters.

B. Only normal construction debris may be discarded in the dumpsters. Any hazardous materials shall be removed from the project by the Contractor creating or responsible for the debris.

3.16 JOBSITE MAINTENANCE

A. Comply with all governing traffic control regulations. Clean streets, sidewalks, paved areas, etc., during progress of the work.

B. Cleaning:

1. Keep the premises free at all times from all waste materials, packaging materials and other rubbish accumulated in connection with the execution of the work by collecting and depositing said materials and rubbish in locations or containers as designated.
2. Clean and remove from own work soiling, staining, mortar, concrete or dirt caused by the execution of the work and make good additional defects resulting there from.
3. At the completion of portions of the Work and the entire completion of Project, remove all tools, equipment, scaffolds, shanties, and surplus materials. Execute all required final cleaning.

C. Depositing rubbish, scrap materials, debris, etc., in dumpsters (in a specified location). Absolutely no burning of debris or trash will be allowed.

3.17 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Maintain facilities in good operating condition until removal. Materials and facilities that constitute temporary facilities are property of Contractor.

B. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Construction Manager's.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 – Closeout Procedures.

END OF SECTION

CML BARNETT BRANCH LIBRARY ADDITION/RENOVATION

3434 East Livingston Avenue

Columbus, OH 43227

SECTION 01 56 39

TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

A. The scope of work includes all labor, materials, tools, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with protection of existing trees and other plants as shown on the drawings and as specified herein.

1. Provide tree and plant protection fencing.
2. Provide protection of root zones and above ground trees.
3. Coordinate with the requirements of Section Planting Soil for modifications to the soil within the root zone of existing trees.
4. Remove tree protection fencing and other protection from around and under trees and plants.
5. Clean up and disposal of all excess and surplus material.

1.02 CONTRACT DOCUMENTS

A. It is the intent of this section that the requirements apply to all sections of the project specification such that any subcontractor must comply with the restrictions on work within designated Tree and Plant Protection Areas.

1.03 REFERENCES

A. References: The following specifications and standards of the organizations and documents listed form a part of the specification to the extent required by the references thereto. If the requirements of the following referenced standards and specification conflict with this specification section the requirements of this specification shall prevail. If the requirements of any of the following referenced standards and specifications conflict with each other the more stringent requirement shall prevail.

1. ANSI A 300 (Part 5) – Standard Practices for Tree, Shrub and other Woody Plant Maintenance, most current editions.
2. Glossary of Arboricultural Terms, International Society of Arboriculture, Champaign Il, most current edition.

1.04 VERIFICATION

A. All scaled dimensions on the drawings are approximate. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions and quantities and shall immediately inform the Owner's Representative of any discrepancies between the information on the drawings and the actual conditions, refraining from doing any work in said areas until given

approval to do so by the Owner's Representative.

1.05 DEFINITION

A. All terms in this specification shall be as defined in the "Glossary of Arboricultural Terms" or as modified below.

B. Reasonable and reasonably: When used in this specification is intended to mean that the conditions cited will not affect the establishment or long-term stability, health, or growth of the plant. This specification recognizes that plants are not free of defects, and that plant conditions change with time. This specification also recognizes that some decisions cannot be totally based on measured findings and that professional judgment is required. In cases of differing opinions, the Owner's Representative expert shall determine when conditions within the plant are judged as reasonable.

C. Shrub: Woody plants with mature height approximately less than 25 feet.

D. Tree and Plant Protection Area: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and defined by a circle centered on the trunk with each tree with a radius equal to the clown dripline unless otherwise indicated by the Owner's representative.

E. Tree: Single and multi-stemmed plants with anticipated mature height approximately greater than 25 feet or any plant identified on the plans as a tree.

1.06 SUBMITTALS

A. Product Data: Submit manufacturer product data and literature describing all products required by this section to the Owner's Representative for approval.

1.07 **OBSERVATION OF THE WORK**

A. The Owner's Representative may inspect the work at any time.

1.08 PRE-CONSTRUCTION CONFERENCE

A. Schedule a pre-construction meeting with the Owner's Representative at least seven (7) days before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.

1. The following Contractors shall attend the preconstruction conference:

a. General Contractor / Subcontractor / persons assigned to Plant Protection measures.

b. Building / Site Contractor / Landscape subcontractor.

B. Prior to this meeting, mark all trees and plants to remain and or be removed as described in this specification for review and approval by the Owner's Representative.

1.09 QUALITY ASSURANCE

A. Contractor qualifications:

1. All applications of pesticide or herbicide shall be performed by a person maintaining a current state license to apply chemical pesticides valid in the jurisdiction of the project.

PART 2 - PRODUCTS

2.01 TREE PROTECTION FENCING

A. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft.; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi.

1. Height: 48 inches.
2. Color: High-visibility orange, nonfading.
3. Post: 6 ft. T-shape galvanized-steel post driven into the ground of sufficient depth to hold the fabric solidly in place without sagging.
    a. Wire Ties: Galv., min. 16-18 gauge wire, 3 per post.

PART 3 - EXECUTION

3.01 SITE EXAMINATION

A. Examine the site, tree, plant and soil conditions. Notify the Owner’s Representative in writing of any conditions that may impact the successful Tree and Plant Protections.

3.02 COORDINATION WITH PROJECT WORK

A. Coordinate with all other work that may impact the completion of the work.

3.03 TREE AND PLANT PROTECTION AREA

A. The Tree and Plant Protection Area is defined as all areas indicated on the tree protection plan. Where no limit of the Tree and Plant Protection area is defined on the drawings, the limit shall be the drip line (outer edge of the branch crown) of each tree.

3.04 PREPARATION

A. Prior to the preconstruction meeting, layout the limits of the Tree and Plant Protection Area and then alignments of required Tree and Plant Protection Fencing. Obtain the Owner’s Representative's approval of the limits of the protection area and the alignment of all fencing.

B. Flag all trees to be removed by wrapping orange plastic ribbon around the trunk and obtain the Owner’s Representative's approval of all trees to be removed prior to the start of tree removal. After approval, mark all trees to be removed with orange paint in a band completely around the

base of the tree or shrub 4.5 feet above the ground.

C. Flag all trees to remain with white plastic ribbon tied completely around the trunk or each tree and on a prominent branch for each shrub. Obtain the Owner's Representative's approval of all trees to be remain prior to the start of tree removal.

D. Prior to any construction activity at the site including utility work, grading, storage of materials, or installation of temporary construction facilities, install all tree protection fencing as shown in the drawings.

3.05 PROTECTION

A. Protect the Tree and Plant Protection Area at all times from compaction of the soil; damage of any kind to trunks, bark, branches, leaves and roots of all plants; and contamination of the soil, bark or leaves with construction materials, debris, silt, fuels, oils, and any chemicals substance. Notify the Owner's Representative of any spills, compaction or damage and take corrective action immediately using methods approved by the Owner's Representative.

3.06 GENERAL REQUIREMENTS: LIMITS FOR OPERATIONS WITHIN PROTECTION AREAS

A. The Contractor shall not engage in any construction activity within the Tree and Plant Protection Area without the approval of the Owner's Representative including operating, moving or storing equipment; storing supplies or materials; locating temporary facilities including trailers or portable toilets and shall not permit employees to traverse the area to access adjacent areas of the project or use the area for lunch or any other work breaks. Permitted activity, if any, within the Tree and Plant Protection Area may be indicated on the drawings along with any required remedial activity.

B. In the event that construction activity is unavoidable within the Tree and Plant Protection Area, notify the Owner's Representative and submit a detailed written plan of action for approval. The plan shall include: a statement detailing the reason for the activity including why other areas are not suited; a description of the proposed activity; the time period for the activity, and a list of remedial actions that will reduce the impact on the Tree and Plant Protection Area from the activity. Remedial actions shall include but shall not be limited to the following:

1. In general, demolition and excavation within the drip line of trees and shrubs shall proceed with extreme care either by the use of hand tools, directional boring and or Air Knife excavation where indicated or with other low impact equipment that will not cause damage to the tree, roots or soil.

2. When encountered, exposed roots, 1-inch and larger in diameter shall be worked around in a manner that does not break the outer layer of the root surface (bark). These roots shall be covered in Wood Chips and shall be maintained above permanent wilt point at all times. Roots one inch and larger in diameter shall not be cut without the approval of the Owner's Representative. Excavation shall be tunneled under these roots without cutting them. In the areas where roots are encountered, work shall be performed and scheduled to close excavations as quickly as possible over exposed roots.

3. Tree branches that interfere with the construction may be tied back or pruned to clear only to the point necessary to complete the work. Other branches shall only be removed when specifically indicated by the Owner's Representative. Tying back or trimming of all branches and the cutting of roots shall be in accordance with accepted arboricultural practices and be performed under supervision of the arborist.
4. Matting (if needed): If work is required in this zone, install temporary matting over Wood Chips or Mulch to the extent required. Do not permit foot traffic, scaffolding or the storage of materials within the Tree and Plant Protection Area to occur off of the temporary matting.
5. Trunk Protection (if needed): Protect the trunk of each tree to remain by covering it with a ring of 8 foot long 2-inch x 6 - inch planks loosely banded onto the tree with 3 steel bands. Staple the bands to the planks as necessary to hold them securely in place. Trunk protection must be kept in place no longer than 12 months. If construction requires work near a particular tree to continue longer than 12 months, the steel bands shall be inspected every six months and loosened if they are found to have become tight.
6. Air Excavation Tool: If excavation for footings or utilities is required within the Tree and Plant Protection Area, air excavation tool techniques shall be used where practical.

3.07 TREE REMOVAL

A. Remove all trees indicated by the drawings and specifications, as requiring removal, in a manner that will not damage adjacent trees or structures or compacts the soil.

B. Remove trees that are adjacent to trees or structures to remain, in sections, to limit the opportunity of damage to adjacent crowns, trunks, ground plane elements and structures.

C. Do not drop trees with a single cut unless the tree falls in an area not included in the Tree and Plant Protection Area. No tree to be removed within 50 feet of the Tree and Plant Protection Area shall be pushed over or up-rooted using a piece of grading equipment.

D. Protect adjacent paving, soil, trees, shrubs, ground cover plantings and understory plants to remain from damage during all tree removal operations, and from construction operations. Protection shall include the root system, trunk, limbs, and crown from breakage or scarring, and the soil from compaction.

E. Remove stumps and immediate root plate from existing trees to be removed. Grind trunk bases and large buttress roots to a depth of the largest buttress root or at least 18 inches below the top most roots whichever is less and over the area of three times the diameter of the trunk (DBH).

1. For trees where the stump will fall under new paved areas, grind roots to a total depth of 18-inches below the existing grade. If the sides of the stump hole still have greater than approximately 20% wood visible, continue grinding operation deeper and or wider until the resulting hole has less than 20% wood. Remove all wood chips produced by the grinding operation and back fill in 8-inch layers with controlled fill of a quality acceptable to the site engineer for fill material under structures, compacted to 95% of the maximum dry density

standard proctor. The Owner's Representative shall approve each hole at the end of the grinding operation.

2. In areas where the tree location is to be a planting bed or lawn, remove all woodchips and backfill stump holes with planting soil as defined in Specification Section Planting Soil, in maximum of 12-inch layers and compact to 80 - 85% of the maximum dry density standard proctor.

3.08 GRADING WITHIN TREE PROTECTION AREAS

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2-inches or less below elevation of finish grade, fill with planting soil mix. Place planting soil in a single uncompacted layer and hand grade to required finish elevations.

3.09 WEED REMOVAL

A. During the construction period, remove weeds and maintain lawn within the Tree Protection area.

B. At the end of the construction period provide one final weeding of the Tree Protection Area.

3.10 CLEAN-UP

A. During tree and plant protection work, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.

1. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways.

B. Once tree protection work is complete, wash all soil from pavements and other structures.

C. Make all repairs to grades, ruts, and damage to the work or other work at the site.

D. Remove and dispose of all excess mulch, wood chips, packaging, and other material brought to the site by the Contractor.

3.11 REMOVAL OF FENCING AND OTHER TREE / PLANT PROTECTION

A. At the end of the construction period or when requested by the Owner's Representative remove all fencing, wood chips or mulch, trunk protection and any other Tree and Plant Protection material.

3.12 DAMAGE OR LOSS TO EXISTING PLANTS TO REMAIN

A. Any trees or plants designated to remain, and which are damaged by the Contractor shall be replaced in kind by the Contractor at their own expense. Trees shall be replaced with a tree of similar species and of equal size or 6-inch caliper whichever is less. Shrubs shall be replaced with a plant of similar species and equal size or the largest size plants reasonably available whichever is less. Where replacement plants are to be less than the size of the plant that is damaged, the Owner's Representative shall approve the size and quality of the replacement plant.

1. All trees and plants shall be installed per the requirements of Specification Section Planting.

B. Plants that are damaged shall be considered as requiring replacement or appraisal in the event that the damage affects more than 25 % of the crown, 25% of the trunk circumference, or root protection area, or the tree is damaged in such a manner that the tree could develop into a potential hazard. The trees and shrubs to be replaced shall be removed by the Contractor at his own expense.

1. The Owner's Representative may engage an independent arborist to assess any tree or plant that appears to have been damaged to determine their health or condition.

C. Any tree that is determined to be dead, damaged, or potentially hazardous by the Owner's arborist and upon the request of the Owner's Representative shall be immediately removed by the Contractor at no additional expense to the owner. Tree removal shall include all cleanup of all wood parts and grinding of the stump to a depth sufficient to plant the replacement tree or plant, removal of all chips from the stump site and filling the resulting hole with topsoil.

D. Any remedial work on damaged existing plants recommended by the consulting arborist shall be completed by the Contractor at no cost to the owner. Remedial work shall include but is not limited to soil compaction remediation and vertical mulching, pruning and or cabling, insect and disease control including injections, compensatory watering, additional mulching, and could include application tree growth regulators (TGR).

E. Remedial work may extend up to two years following the completion of construction to allow for any requirements of multiple applications or the need to undertake applications at required seasons of the year.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in the Project; product delivery, storage, and handling; project compliance and selection procedures, manufacturers' standard warranties on products; special warranties; comparable products and general installation procedures.

B. Related Sections/Documents:

1. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
2. Section 01 33 00 – Submittal Procedures: Requirements for submittals.
3. Section 01 42 00 – Reference Standards, and Definitions for applicable industry standards for products specified.
4. Section 01 78 00 – Project Closeout for submitting warranties for contract closeout.

1.02 DEFINITIONS

A. Definitions in this paragraph are not intended to change the meaning of other terms used in Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," "furnishings," "special construction," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.

B. "Basis-of-Design" or "Standards" Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating equivalent products of additional manufacturers named in the specification.

C. "Products" are items purchased for incorporation in the Work. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

D. "Named Products" are items identified by manufacturer's product name, including make or model number or other designation, shown or listed the manufacturer's published product literature, that is current as of the date of the Contract Documents.

E. "Comparable Product" is a product that is demonstrated and approved through the submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified standard or basis-of-design product.

F. "Materials" are products substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form part of the Work.

G. "Equipment" is defined as products with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.03 SUBMITTALS

A. Within 30 days after execution of the Subcontract, and in accordance with the Special Conditions submit the proposed "Standards." Provide a written explanation for omissions of data and for known variations from Contract requirements.

B. Prepare a schedule of "Standards" showing products specified in tabular form acceptable to the Architect. Include the manufacturer's name and proprietary product names for each item listed. Coordinate product list with the Contractor's Construction Schedule and the Schedule of Submittals.

1. Prepare product list with information on each item tabulated under the following column headings:

a. Related Specification Section number.
b. Generic name used in Contract Documents.
c. Proprietary name, model number, and similar designations.
d. Manufacturer's named and address.
e. Supplier's name and address.
f. Installer's name and address.
g. Projected delivery date or time span of delivery period.

C. Substitution Requests: Refer to Section 01 25 00 – Substitution Procedures.

1.04 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible for each unit of Work, provide products, materials or equipment of a singular generic kind and from a single source.

B. When specified products are available only from sources that do not or cannot produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect for a determination of the most important product qualities before proceeding. Qualities may include attributes relating to visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources that produce products that possess these qualities, to the fullest extent possible.

C. When the Contractor is given the option of selecting between two (2) or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle and store products according to the manufacturer's recommendations using methods and means that will prevent damage, deterioration, and loss, including theft.

1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
2. Coordinated delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
9. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
10. Protect stored products from damage and liquids from freezing.

1.06 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for the Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. Refer to Divisions 02 through 50. Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section governing project closeout procedures.

PART 2 – PRODUCTS

2.01 GENERAL PRODUCT COMPLIANCE

A. General: The compliance requirements, for individual products as indicated in Contract Documents, are multiple in nature and may include generic, descriptive, proprietary, performance, prescriptive, compliance with standards, compliance with codes, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with.

1. Provide products that comply with the requirements of the Contract Documents, which are undamaged and, new at the time of installation. Select products, materials, or equipment in accordance with “Product Selection Procedure”.
2. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and for the intended use and effect.
3. Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

2.02 PRODUCT SELECTION PROCEDURE

A. General Product Requirements:

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. As Approved: When one or more manufacturers' products are specified followed by the words "as approved," or words to that effect, including “or equal” and “equal to,” comply with specified submittal and approval requirements for product substitutions.
8. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "as approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Basis-of-Design Product: Where Specifications or Drawings name a product and include a list of other acceptable manufacturers, provide the specified or indicated product or an equivalent product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers. Where no other manufacturers are named for basis-of-design specifications, products of other manufacturers may be submitted; comply with “Comparable Products” requirements.
2. Named Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.

4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
6. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 Article for consideration of an unnamed product.
7. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 Article for consideration of an unnamed product.
8. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
9. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
    c. Custom Color or Range: Where Specifications include the phrase "custom color, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from a palate separate from manufacturer's standard and premium items.

2.03 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for a comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. The product option and selection procedure, as described in this Section, governing the specified product:

    a. allows the Contractor to make comparable product requests.
    b. does not require the use of the product substitution procedure.

2. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
3. Detailed comparison of significant qualities of proposed product with those named in the Specifications.
4. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
5. Evidence that proposed product provides specified warranty.
6. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
7. Samples, if requested.
8. By proposing a product that is not listed, for consideration as a comparable product, the Contractor affirms that it meets requirements, except where clearly indicated otherwise. Approval, if granted, will be contingent upon the product meeting requirements as comparable product. In the absence of clear indication of non-compliance in product submittal, approval of the comparable product by Architect, will be based on Contractor’s affirmation, whether explicit or implicit.

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 73 00

EXECUTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Progress cleaning
5. Starting and adjusting.
6. Protection of installed construction.
7. Correction of the Work.

B. Related Sections include the following:

1. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
2. Section 01 73 29 – Cutting and Patching for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
3. Section 02 41 19 – Selective Demolition for demolition and removal of selected portions of the building.

1.02 SUBMITTALS

A. Before installing new utility connections, review location of utilities in the field with each utility company and submit utility company approval to the Owner.

1.03 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of storm sewer, and water-service piping; underground electrical services, and other utilities.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect through the Construction Manager according to requirements in Section 01 31 00 – Project Management and Coordination.

3.03 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Construction Manager promptly.

B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.04 FIELD ENGINEERING

A. Contractor shall engage the services of a land surveyor if required to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of major elements as the Work progresses.
6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

B. Identification: Owner will identify existing benchmarks, control points, and property corners. The General Contractor shall verify locations by survey before commencing work.

C. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly.
2. Report the need to relocate permanent benchmarks or control points to Construction Manager before proceeding.
3. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

D. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

E. Certified Survey: On completion of work requiring field-engineering services, prepare a certified survey as required by authorities having jurisdiction showing dimensions, locations, angles, and elevations of construction and sitework.

3.05 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Protect concrete floor which is to have an exposed finish, or is to have a polished concrete finish from staining and other damage until substantial completion. Cutting of pipe and similar operations that may stain flooring shall not be done at locations scheduled to have a resilient sheet flooring or carpeting as the finished floor covering.

D. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

E. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

F. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

G. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

H. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

I. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

J. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

K. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.06 OVERHEAD ATTACHMENTS

A. For required hangers each trade to provide one or more of the following:

1. Concrete inserts prior to placement of concrete.
2. Trapeze from adjacent structure with suitable steel framing.

a. Connections to Structure: Suitable anchorage devices with a minimum load carrying capacity of 250 lbs. plus a safety factor of 4:1 for the applied load:
b. Concrete: Steel expansion anchors. See PROHIBITED MATERIAL & METHODS below.
c. Steel: Bolted or welded connections to steel structure.

B. Where metal floor deck is furnished with hangar tabs or similar devices, applied total load, including work of other trades, not to exceed 75 lbs. for each device. Loads in excess of permitted limit to be supported by trapeze framing as specified above.

C. Verify support requirements of heavy or unusual loads not specifically shown on drawings with Architect.

3.07 PROHIBITED MATERIALS AND METHODS

A. The following items are expressly prohibited:

B. Core Drilling: Not permitted unless approved by Structural Engineer.

C. Attachment Related Items:

1. Ballistic Fasteners: Ballistic fasteners are defined as anchors which are driven into place by any device which produces an impact force by use of a powder charge, compressed air, gas or any other propellant. Ballistic fasteners prohibited for the following conditions:

a. Attachment of structural members.
b. Where public may be endangered by misuse.

2. Suspension systems which are not independently supported:

a. Ceiling grid systems shall not be supported from ductwork, electrical conduit, heating or plumbing lines, and vice versa.

b. Each utility system and the ceiling grid system shall be a separate installation and each shall be independently supported from the building structure.
c. Where interference occurs, provide trapeze type hangers or other suitable supports for each system.
d. Locate hangers and supports where they will not interfere with access to mixing boxes, fire dampers, valves, and other appurtenances requiring servicing.
e. See OVERHEAD ATTACHMENTS above.

3. Plug anchorage by use of wood, lead, or plastic.
4. Perforated steel strap iron for pipe or other support or anchorage.
5. Penetration of cellular (electrical) deck by fasteners or welding except as required for installation of deck system and associated electrical work.

D. Methods Related Items:

1. The penetration of floors and of walls by pipes, ducts, or other penetrations unless openings are appropriately fire stopped by fire doors, or fire dampers, and voids around pipes, ducts, conduits, etc. are sealed with fireproof materials.
2. The use of ink marking pens on surfaces of any kind of materials receiving paint or other finish in exposed location.
3. Use of jack hammers or other similar equipment which can cause structure-borne vibration detrimental to the use of the existing facilities, (i.e.: surgical functions).

3.08 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.09 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 01 45 00 – Quality Control.

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 01 73 29 – Cutting and Patching.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes requirements and limitations for cutting, demolition, removal work, patching and restoration of work as necessary to accomplish and complete all work under the Contract, including relocation or reuse of existing materials, equipment, systems, or other work, as well as the disposition of salvaged materials or debris.

1. This Section applies to all work under the Contract, including general construction, mechanical and electrical work.

B. Related Sections:

1. Drawings and general provisions of Contract, including General Conditions and Division 01 Specification sections, apply to Work of this section. Such sections include, but are not limited to the following items:

a. Section 01 33 00 – Submittal Procedures: Requirements for submittals.
b. Section 01 73 00 – Execution
c. Section 02 41 19 – Selective Demolition for demolition of selected portions of the building for alterations.

2. Divisions 03 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

a. Requirements in this Section apply to mechanical and electrical installations. Refer to Division 20 and 30 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.02 DEFINITIONS

A. "Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.

1. "Cutting and patching" is performed for coordination of the Work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.

a. Cutting and patching performed during the manufacturer of products, or during the initial fabrication, erection or installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners and similar operations are also not considered to be "cutting and patching."

2. “Patching”: Fitting and repair work required to restore surfaces to original conditions after installation
3. "Selective Demolition" is a related but separate category of work which may or may not require cutting and patching required in this section; refer to individual specification sections.

1.03 SUBMITTALS

A. Procedural Proposal for Cutting and Patching: Prior approval of cutting and patching is required for work which is not identified or inferred from the Contract Documents; therefore, submit proposed procedures for this work well in advance of the time work will be performed and request approval to proceed. Include the following information, as applicable, in the submittal.

1. Describe nature of the work and how it is to be performed, indicating why cutting and patching cannot be avoided. Describe anticipated results of the work in terms of changes to existing work, including structural, operational and visual changes as well as other significant elements.
2. List products, equipment, and techniques to be used and firms that will perform work.

3. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
    b. Include contingency plan addressing additional resources, alternative means of communicating, unexpected defective valves and/or breakers, security arrangements and change in schedule due to resident activities.
    c. Identify who are the authorized decision makers for the Owner and Contractor. .
4. Give a schedule of dates when work is expected to be performed.
5. List products, equipment, and techniques to be used and firms that will perform work.
6. Where cutting and patching of structural work involves the addition of reinforcement it shall be integrated with original structure to satisfy requirements.
7. Approval by the Construction Manager to proceed with cutting and patching work does not waive the Architect's right to later require complete removal and replacement of work found to be cut and patched in an unsatisfactory manner.
8. Furnish adequate collection and removal of water for concrete cutting and coring.

1.04 QUALITY ASSURANCE

A. Before cutting and patching decorative finish material to remain in the work, obtain the Construction Manager's approval to proceed. Review cut and patch procedures involved in the work with the Construction Manager prior to start of such work.

B. Do not cut and patch operational elements or safety related components in a manner that would result in a reduction of their capacity to perform in the manner intended, included energy performance, or that would result in increased maintenance, or decreased operational life or decreased safety.

C. Cut and patch in a manner that is compatible with the building's aesthetic qualities. Do not cut and patch work in a manner that would result in substantial visual evidence of cut and patch work. Review cut and patch procedures involved in the work with the Architect prior to start of such work. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

D. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio. Review cutting of structural elements (concrete slab, beams etc) with Construction Manager prior to starting work. Refer to structural drawing for recommendation for cutting and patching of floor slabs. Refer to structural drawing for required lintels for new openings.

1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
    a. Foundation construction
    b. Bearing and retaining walls
    c. Structural concrete
    d. Structural steel
    e. Lintels
    f. Timber and primary wood framing
    g. Structural decking
    h. Stair systems
    i. Miscellaneous structural metals
    j. Exterior curtain wall construction
    k. Equipment supports
    l. Piping, ductwork, vessels, and equipment
2. Cutting and Patching Concrete: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical, electrical trades and Owner. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

E. Operational Elements and Safety Limitations: Do not cut and patch operating elements and safety related components in a manner that results in reducing their capacity to perform as intended or which results in increased maintenance or decreased operational life or safety.

1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:

    a. Shoring, bracing, and sheeting
    b. Primary operational systems and equipment
    c. Fire separation assemblies
    d. Air or smoke barriers
    e. Fire suppression assemblies
    f. Mechanical systems piping, ducts and vessels
    g. Water, moisture, or vapor barriers
    h. Membranes and flashings
    i. Equipment supports
    j. Fire protection systems
    k. Fire detection and alarm systems
    l. Sprayed fire-resistive material/fire-rated structural components
    m. Noise and vibration control elements and systems
    n. Stairs
    o. Control systems
    p. Communication systems
    q. Conveying systems
    r. Electrical wiring systems
    s. Operating systems of special construction

F. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity which results in reducing their capacity to perform as intended, or which results in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Equipment supports.
4. Piping, ductwork, vessels, and equipment.
5. Noise- and vibration-control elements and systems.

1.05 COORDINATION

A. Provide cutting of existing construction for the installation of the work, to uncover work for access or inspection, for coordination with other work, or for similar purposes, and provide for patching required to restore surfaces to original or modified condition.

B. Determine the location and size of opening required for the installation of the work. Cost of cutting and patching shall be borne by the Contractor requiring the opening or access.

C. Coordinate the locations and installation of sleeves and supporting devices to be installed in the construction for the installation of the work of all trades.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Provide same products or types of construction as that in existing structure, as needed to patch, extend, or match existing work. Generally, Contract Documents do not define product or standards of workmanship present in existing construction; Contractor shall determine products by inspection and necessary testing and workmanship by use of the existing as a sample for comparison.

B. Materials for patching shall match existing adjacent surfaces to the fullest extent possible with regard to visual effect and installed performance characteristics.

C. Presence of a product, finish, or type of construction, required that patching extending, or matching shall be performed as necessary to make work complete and result in equal or better standards of quality.

PART 3 – EXECUTION

3.01 INSPECTION

A. Before cutting existing surfaces, examine the surfaces to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work.

B. Before the start of cutting work, coordinate layout of the work and resolve potential conflicts before proceeding.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Temporary Support: Provide temporary support to ensure structural integrity of affected portions of Work.

1. Provide devices and methods to protect other portions of Project from damage.
2. Provide materials and control operations to prevent spread of dust in surrounding area. Provide drop cloths or other suitable barriers.

B. Protect in place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for that part of the project that may be exposed during cutting and patching operations.

C. Take precautions not to cut existing pipe scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 CUTTING REQUIREMENTS

A. Perform cutting and removal of existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

B. Employ skilled workmen capable of matching existing quality of existing construction to perform cutting and patching work. Proceed with cutting and patching at the earliest feasible time and complete work without delay.

C. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize or preferably to prevent interruption to occupied areas.

D. Cut, fit and patch, including excavation and backfill, to complete Work and to:

1. Fit several parts together, to integrate with other work.
2. Uncover portions of work to provide for installation of ill-timed work.
3. Remove and replace defective work.
4. Remove and replace work not conforming to requirements of Contract Documents.
5. Remove samples of installed work as necessary for testing.
6. Provide openings in elements of work for penetrations of plumbing, mechanical, and electrical work.
7. Uncover work to allow for Architect’s observation of covered work which has been covered up prior to required observation by Architect.

3.04 CUTTING AND REMOVAL REQUIREMENTS

A. Cut and remove existing construction as required, to accomplish the Work. Where new Work is to be installed in or adjacent to existing construction or existing work is to be replaced, remove or cut the existing construction as necessary to complete the Work of the Project.

B. Execute work with care. Existing construction that is to remain which is loosened, cracked, or otherwise damaged or defaced as a result of the cutting and is unsuitable for use intended shall be removed and replaced at no additional cost to the Owner.

C. Perform cutting and removal work to remove minimum materials and surfaces necessary using methods that are least likely to damage elements to be retained. Protect adjoining finishes to remain from damage.

1. In general, where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut through masonry using a cutting machine such as a carborundum saw or diamond core drill to ensure a neat hole. Cut finish surfaces such as masonry, clay tiles or metals using methods to terminate surfaces in a straight line at a natural point of division. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces. Temporarily cover openings when not in use.
2. By-pass utility services such as pipe, before cutting, where such utility services are shown or required to be removed, relocated or abandoned. Cut off pipe in walls or partitions to be removed. After by-pass and cutting; cap, valve or plug and seal tight remaining portion of pipe and conduit to prevent entrance of moisture or other foreign matter.
3. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
4. Remove existing construction as noted or required to be removed in order to accommodate new work.

D. Where removal of walls or partitions extends from one finish surface to another, patch and repair floor and wall surfaces to provide and even surface of uniform color and appearance. Remove existing floor and wall finish materials and replace with new materials, if necessary to achieve uniform color and appearance, with no evidence of patching.

3.05 PATCHING REQUIREMENTS

A. Patch or otherwise restore disturbed existing construction as indicated on the drawings and schedules, or as otherwise required to restore the work and surfaces. Patching or restoration shall be carried to natural breaks (i.e., corners) wherever possible. Where existing construction is removed, cut or otherwise disturbed by Work of the Project, patch defective and incomplete surfaces. Repair any damage to existing construction which is to remain.

B. Patching work shall be done by skilled mechanics experienced in the particular type of work involved and shall conform to the standards of the Specifications.

C. Patch existing construction to match existing work (unless otherwise called for) except provide new materials and accomplish as for new work. Examine existing surfaces to be patched before proceeding with the work. Report to the Architect conditions where existing materials, colors and finishes cannot be matched, and do not proceed until instructions have been given.

D. Construction that has been damaged as a result of the Work shall be repaired to an extent and as required to match adjacent existing undamaged construction.

E. Patch with durable seams that are as invisible as possible. Comply with specified tolerances for the work.

1. Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work.
2. Fit work tight to new sleeves, pipes, ducts, conduits and other penetrations through the wall surface.
3. At penetrations of fire rated wall and ceiling or floor construction, completely seal voids with fire-resistive sealant materials in accordance with Section 07 84 00 – Firestopping, to full thickness of the penetrated element.
4. Inspect and test patched areas to verify integrity of the installation.
5. Restore surfaces and conditions exposed by removal of existing equipment, features and items, i.e., holes, recesses, interruption of continuity of finishes, etc.
6. Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

7. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
8. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

F. Holes in openings left after removal of items under selective demolition must be filled with like construction to match adjacent finish.

G. Restoration: Except where indicated otherwise, restore exposed finishes of patched areas to match adjacent surfaces and where necessary extend finish restoration into retained adjoining surfaces in manner which will eliminate evidence of patching and refinishing. Thoroughly clean surfaces prior to application of paint and other finishes.

1. Where patching occurs in previously painted surface, provide appropriate prime coat followed by first finish coat of paint. Provide final finish coat over entire area containing patch; for continuous surface extend to nearest vertical break or intersection, for an assembly refinish entire unit. Except where indicated otherwise, finish in sheen and color to match adjacent surfaces.

3.06 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching work is performed or used as access to work. Completely remove mortar, debris, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

B. Perform progress cleaning as specified in Section 01 73 00 – Execution.

END OF SECTION

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout including, but not limited to the following:

1. Substantial Completion procedures
2. Final Completion procedures
3. List of incomplete items (punch list)
4. Warranty requirements
5. Final cleaning

B. Related Sections/Documents:

1. Section 01 73 00 – Execution: For progress cleaning of Project site.
2. Section 01 78 23 – Operation and Maintenance Data: For operation and maintenance manual requirements.
3. Section 01 78 39 – Project Record Documents: For submitting record Drawings, record Specifications, and record Product Data.
4. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.02 SUBMITTALS

A. Product Data: For cleaning agents.

B. Construction Manager's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

D. Certificates of Release: From authorities having jurisdiction.

E. Certificate of Insurance: For continuing coverage.

F. Field Report: For pest control inspection.

G. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.03 DESCRIPTION OF REQUIREMENTS

A. Definitions: Closeout is hereby defined to include general requirements near end of Contract Time, in preparation for final acceptance, final payment, normal termination of contract, occupancy by Owner and similar actions evidencing completion of the Work.

1. Specified requirements for individual units of Work are specified in sections of Division 01 through 50.
2. Time of closeout is directly related to "Substantial Completion," and therefore may be either a single time period for entire Work or a series of time periods for individual parts of the Work which have been certified as substantially complete at different dates. That time variation (if any) shall be applicable to other provisions of this section.

1.04 SUBSTANTIAL COMPLETION PROCEDURES

A. Construction Manager's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Construction Manager's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion.

C. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner’s signature for receipt of submittals.

5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

D. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 - Demonstration and Training.
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

E. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Construction Manager of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Construction Manager of items, either on Construction Manager's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.05 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 - Payment Procedures.
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Construction Manager of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Construction Manager of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.06 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Construction Manager.
    d. Name of Architect.
    e. Name of Contractor.
    f. Page number.

4. Submit list of incomplete items in the following format: PDF electronic file and as an Excel spreadsheet.

B. Re-inspection procedure: Upon receipt of Contractor's notice that the Work has been completed, including punch-list items resulting from earlier inspections, and excepting incomplete items delayed because of acceptable circumstances, Construction Manager and Architect will re-inspect the Work. Upon completion of re-inspection, Construction Manager and Architect will either prepare certificate of final acceptance or advise Contractor of Work not completed or obligations not fulfilled as required for final acceptance. If necessary, procedure will be repeated.

1.07 WARRANTY REQUIREMENTS

A. Submit written warranties to the Construction Manager prior to the date for Final Completion. If the Certificate of Final completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the work, submit written warranties upon request of the Construction Manager.

B. Refer to individual sections of Divisions 02 through 50 for the determination of units of Work which are required to be specifically or individually warranted, and for the specific requirements and terms of those warranties (or guarantees).

C. Manufacturer’s disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer’s disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

D. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

E. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

F. Replacement Cost: Upon determination that Work covered by the warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirement of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

G. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations. rights, or remedies.

1. The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

H. When the Contract documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

I. When the Contract documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Construction Manager, for approval prior to final execution. Refer to Divisions 02 through 50 sections for specific content requirements and particular requirements for submitting special warranties.

J. Submit 15 days prior to completion, 2 copies of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into and orderly sequence based on the table of contents of the Project Manual. When warranted construction requires operation and maintenance manuals provide additional copies of each required warranty, as necessary, for inclusion in each manual.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 – PRODUCTS

3.01 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Provide final cleaning of the Work employing experienced workers or a professional cleaning company for final cleaning. Clean each surface or unit of work in the work area to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's specific instructions for cleaning operations for materials installed and specified herein.

C. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion for the entire Project or for a portion of the Project.

1. Clean Project Site, including landscape development areas of rubbish, waste materials, litter and foreign substances. Sweep paved areas to broom clean condition; remove stains, chemical spills, and other foreign deposits. Rake grounds which are neither planted or paved, to a smooth, even textured surface. Remove stains, spills and other foreign deposits.
2. Remove tools, construction equipment, machinery and surplus materials from the site.
3. Clean exposed exterior and interior hard-surfaced finishes affected by the work to a dirt-free condition, free of dust, stains, films and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
4. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces. Sweep concrete floors broom clean in unoccupied spaces.
5. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
6. Damp Wiping: Use a clean damp cloth or sponge to remove all dirt, spots, streaks and smudges from walls, doors (both wood and metal), glass and other specified surfaces. When dry, the surfaces shall have a polished appearance. The wetting solution shall contain an appropriate cleaning agent.

7. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
8. Clean transparent materials, including mirrors and glass in doors and windows. All glass shall be clean and free of dirt, grime, streaks, excessive moisture and shall not be cloudy Polish mirrors and glass, taking care not to scratch the surfaces.
9. Metal surfaces such as hardware, frames, cover plates, shall be cleaned with a damp cloth and polished where required.
10. For all operations where furniture or equipment is moved, no chairs, waste baskets or other similar items shall be stacked on desks, tables or window sills. Upon completion of work, all furniture and equipment must be returned to its original position or as directed by the Construction Manager.
11. Remove labels that are not permanent labels. Clean all permanent labels.
12. Touch-up and otherwise repair and restore marred exposed finishes and surfaces. Replace finishes and surfaces which cannot be satisfactorily repaired or restored, or show visible evidence or repair or restoration. Do not paint over UL and similar labels including mechanical and electrical identification plates.
13. Wipe surfaces of mechanical and electrical equipment, elevator equipment and similar equipment clean. Remove excess lubrication, paint and other foreign substances.
14. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
15. Overhead items, such as louvers, grilles, pipes, molding, etc., shall be dusted, vacuumed and spot cleaned.
16. Supply vents, exhaust grilles and room fan coil units shall be thoroughly vacuumed and cleaned.
17. Clean exposed unpainted ductwork of all foreign matter.
18. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers and grilles. Clean ducts, blowers and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.
19. Clean light fixtures, including glass and plastic lenses, ceiling and wall-mounted lights, cover panels, side panels, louvers, fixture frames and lamps.
20. Light fixture lamps are to function with full efficiency. Replace burned out bulbs and defective and noisy starters in fluorescent fixtures.
21. Leave Project clean and ready for occupancy.

D. At the completion of the Work, remove all tools, equipment, scaffolds, shanties, and surplus materials.

E. Removal of Protection: Remove temporary protection devices and facilities which were installed during course of the Work to protect previously completed Work during remainder of construction period.

F. Leave each area of the Project clean and ready for occupancy by the Owner. Maintain cleaning until acceptance by the Owner.

3.02 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINATENANCE DATA

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Emergency manuals
2. Operation manuals for systems, subsystems, and equipment.
3. Product maintenance manuals.
4. Systems and equipment maintenance manuals.

B. Related Sections/Documents:

1. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
2. Section 01 33 00 – Submittal Procedures: For submitting copies of submittals for operation and maintenance manuals.
3. Section 01 77 00 – Closeout Procedures
4. Divisions 02 through 50 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.02 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.03 ACTION SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual specification sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to modifications and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Owner.
    a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
    b. Enable inserted reviewer comments on draft submittals.
2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Owner, will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Agent will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Agent will return copy with comments.

1. Correct or modify each manual to comply with Architect's and Commissioning Agent's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Agent's comments and prior to commencing demonstration and training.

PART 2 – PRODUCTS

2.01 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each operation and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.02 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Construction Manager.
6. Name and contact information for Architect.
7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
8. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable sizes. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Organization: Enable organization of individual documents based upon file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite files.

a. Create composite manual with bookmarks, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel upon opening file.
b. Name, configure, and organize files and in accordance with COBIE procedures.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold (8-1/2-by-11-inch) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
b. Avoid placing loose, oversize drawings in binder pockets. Use reduced drawings or place folded drawings in labeled envelopes bound in manual.
c. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.03 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.

9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Demonstration and Training: Provide labor for miscellaneous demonstration and training support during the warranty term.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.04 PRODUCT MAINTENANCE MANUALS

A. General: Information for care and maintenance shall be furnished for any item requiring more than ordinary custodial care. For mechanized equipment and electrical equipment, provide operation manuals. For special equipment, in addition to operation manuals, provide the original equipment manufacturers' demonstrations and operating instructions by factory trained employees to designated Owner personnel who will be operating the equipment.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties: Include copies of warranties and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.05 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and

service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties: Include copies of warranties and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 – EXECUTION

3.01 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.

2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Section 01 78 39 –Record Documents.

G. Comply with Section 01 77 00 – Closeout Procedures for schedule for submitting operation and maintenance documentation.

END OF SECTION

SECTION 01 78 39

RECORD DOCUMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for project record documents including the following:

1. Record Drawings.
2. Record Specifications.
3. Miscellaneous record submittals

B. Related Sections:

1. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
2. Section 01 33 00 – Submittal Procedures: Electronic document submittal requirements.
3. Section 01 78 00 – Project Closeout for general closeout procedures.
4. Section 01 78 23 – Operation and Maintenance Data for operation and maintenance manual requirements.
5. Divisions 02 through 50 Sections for specific requirements for project record documents of the Work in those Sections.

1.02 DEFINITIONS

A. Project Record Documents: Contract drawings, specifications, and shop drawings, indicating "As-Built" conditions and actual products selected for use.

1.03 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposes, protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for Architect's reference during normal working hours.

B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark set to show the actual installation where installation varies substantially from Work originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements difficult to measure and record at a later date.

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of Work.
2. Mark new information important to Owner, but not shown on Contract Drawings or Shop Drawings, including the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations below first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order and other contract modifications.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Note related Change Order numbers, Field Order numbers, and other contract modifications, where applicable.
4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.

C. Electronic Submittals: Record Drawings:

1. Initial Submittal: Submit one set(s) of corrected Record CAD Drawings in electronic AutoCAD .dwg format and one set(s) of marked up Record prints. The following file formats will not be accepted: (.tif, .jpg, .jpeg, .pdf). Architect will initial and date each Record CAD drawing and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. Architect will return Record Drawings and prints for organizing into sets, printing, binding, and final submittal.
2. Final Submittal: Submit one set(s) of Record CAD Drawings, one set of marked-up Record prints, and three copies printed form Record CAD drawings. Print each drawing, whether or not changes and additional information were recorded.

D. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.

1. Legibly mark and record at each “Product” section of each Specification Section, the description of the actual products installed, including the following:

    a. Manufacturer’s name and product model and number.
    b. Product substitutions or alternates utilized.
    c. Changes made by Addenda or Bulletin.

2. Upon completion of the Work, submit record Specifications to Architect for Owner's records.

E. Record Product Data: Maintain one copy of each Product Data submittal. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site, and from manufacturer's installation instructions and recommendations.

1. Legibly mark each Product Data submittal indicating actual product number and model installed in the Work.
2. Note related Change Orders.
3. Markup applicable record drawings and Specifications.
4. Upon completion of markup, submit complete set of record Product Data to Architect for Owner's records.

F. Maintenance Manuals: Organize operating and maintenance data into suitable sets of manageable size.

1. At a minimum, Operation and Maintenance Manuals shall contain:

    a. Manual index cross referencing specification numbers for each item.
    b. Operating instructions.
    c. Emergency instructions.
    d. Spare parts list.
    e. Copies of warranties.
    f. Wiring diagrams.
    g. Recommended maintenance procedures and “turn around” cycles.
    h. Inspection and system-test procedures.
    i. Copies of applicable Shop Drawings.
    j. Copies of applicable Product data.
    k. Fixture lamping schedule.
    l. Maintenance drawings and diagrams.
    m. Listing of required maintenance materials.
    n. Precautions against improper maintenance.
    o. All organized by Specification Section.
    p. Names and addresses of nearest service outlets, distributors, or factory outlets for each piece of equipment.

2. Commence preparation of manuals after Shop Drawings and Product Data submittals have been accepted.

3. Finished manuals shall be heavy-duty loose-leaf type 3-ring binders with hardboard covers and titled tabs identifying each particular portion or item of Work.

    a. Provide binders with pocket folders for folded sheet information.
    b. Provide each binder a detailed Table of Contents referring to index tabs.

4. For each titled item or work portion, manual must provide names, addresses, and phone numbers of the following parties:

    a. Contractor/installer.
    b. Manufacturer.
    c. Nearest dealer/supplier.
    d. Nearest agency capable of supplying parts and service.

5. Each manual label on front cover or spine shall indicate the following information.

    a. Project name and address.
    b. Owner’s name.
    c. Name and address of Architect.
    d. Name and address of Contractor.
    e. Name and address of Subcontractor.
    f. Date of Submission.

6. Submit three copies of maintenance manuals to Architect for Owner's records.

G. Miscellaneous Record Submittals: Refer to other specification sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of the work. Immediately prior to the date or dates of final completion, complete miscellaneous records and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to the Architect for the Owner’s records.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.

B. Related Sections include the following:

1. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
2. Section 01 31 00 – Project Management and Coordination for requirements for pre-instruction conferences.
3. Divisions 02 through 50 Sections for specific requirements for demonstration and training for products in those Sections.

1.02 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. At completion of training, submit one complete training manual(s) for Owner's use.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

C. Demonstration and Training Videotapes: Submit two copies within seven Insert number days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Construction Manager.
e. Date videotape was recorded.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

2. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

1.03 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 - Quality Requirements, experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 – Project Management and Coordination. Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.04 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 – PRODUCTS

2.01 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:

   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project Record Documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 – EXECUTION

3.01 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 – Operations and Maintenance Data.

B. Set up instructional equipment at instruction location.

3.02 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least ten days' advance notice.

D. Training Location and Reference Material: Conduct on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and remove from Project site.

G. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.03 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on video recording by audio narration by microphone while dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

F. Pre-Produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes the following:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.
4. Removal and disposal of all debris.
5. Disconnecting and relocating/reinstalling any existing utility lines on the site which interferes with the repairs.
6. Protection of all existing electrical systems, mechanical equipment, light fixtures, overhead piping, fire protection system etc. scheduled to remain.

B. Related Sections:

1. Section 01 33 00 – Submittal Procedures
2. Section 01 50 00 – Temporary Facilities and Controls: Temporary Utilities and Protection requirements during construction operations.
3. Section 01 73 00 – Cutting and Patching
4. Section 01 77 00 – Closeout Procedures: Project Record Documents

1.02 DEFINITIONS

A. Demolish: The term "demolish" shall mean to wreck or destroy a structure or building system assembly (such as floor or ceiling system, walls or partitions, etc.) and the removal of wrecked materials from the job site. Where new work is not specified for the adjoining surface, selective demolition shall require "cutting and patching" wherever demolished portions of a structure adjoin portions to remain.

B. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

C. Protect: The term "protect" shall mean to cover, enclose, shield or take other designated measures to avoid damage or harm. Items protected will either remain in place, or will be salvaged for re-installation in the Work. The type of protection shall be as specified. Where the type of protection is not specified, items shall be protected from any and all damage, scratches, marking, overspray, dripping, deterioration, or movement from any and all activities scheduled to take place on this Project, and/or would be typical to a Project site such as this one.

D. Remove: The term "remove" shall mean to detach or separate an item, component or assembly from its installed location, and dispose of same. Removal shall be accomplished without damage to adjacent materials, components or systems that are to remain. Damage that must be incurred during removal shall be repaired as cutting and patching.

E. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated or where required as new work.

F. Salvage: The term "salvage" shall mean the removal of items, components, equipment or materials from their installed location, and protection and storage of such items, components, equipment or materials. Salvaged items will be designated either to be re-installed in the Work, stored, or turned over to the Owner or other designated entity, plus such other work as described.

G. Store: The term "store" shall mean to protect and place in a designated area. Where an area is not designated, the Contractor responsible for the item shall provide adequate and reasonable facilities acceptable to the Owner's representative.

1.03 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.04 PRE-SELECTIVE DEMOLITION MEETING

A. Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.
6. Review coordination with activities of Environmental Abatement Contractor.

1.05 ACTION SUBMITTALS

A. Prepare submittals in accordance with the provisions of Section 01 33 00 – Submittal Procedures.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust and noise control. Indicate proposed locations and construction of barriers.

C. Prior to commencement of demolition work, contractors shall submit a schedule of work detailing all anticipated demolition and removal procedures and operations. Schedule shall be approved by the Architect. Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure building's staff on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
6. Means of protection for items to remain and items in path of waste removal from building.

D. Prepare and submit for approval, drawings of the portions of existing building where openings will be cut in existing construction, showing size and location of openings to be made in existing construction.

E. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of selective demolition.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property . Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and reinstalled and items to be removed and salvaged.

E. Predemolition Photographs or Video: Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.07 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 77 00 – Contract Closeout.

B. Accurately record actual locations of capped utilities, subsurface obstructions, and utility lines, on project record documents.

1.09 QUALITY ASSURANCE

A. Applicable federal law and local codes shall apply to work under this section including, but not limited to, the following:

1. National Fire Protection Association
2. National Electric Code

B. Do not use jack hammers or other heavy duty impacting type tools for demolition work without permission of the Architect.

C. Verify that utility supply lines have been shut off before removal.

D. Provide fire extinguishers on site of multi-use type during demolition work.

E. Comply with applicable safety codes for demolition work.

F. Pay all required fees and obtain all necessary permits and licenses required for demolition work.

1.10 REGULATORY REQUIREMENTS

A. Conform to the applicable requirements of the Ohio Basic Building Code, Ohio EPA regulations, for demolition of structures, safety of adjacent structures, dust control, and disposal procedures.

B. Obtain necessary permits from authorities having jurisdiction.

C. Notify affected utility companies before starting work and comply with their requirements.

D. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.

E. Do not close or obstruct egress width to exits. Maintain protected egress and access at all times.

1.11 EXISTING CONDITIONS

A. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

B. Refer to the Drawings for extent of selective demolition and removal work.

C. Hazardous Materials: Hazardous materials are present in building and structure to be selectively demolished. A report on the presence of hazardous materials can be found in Section 00 31 26 “Information for Bidders – Existing Hazardous Materials Information” and additional documents prepared by _____ for the Owner. Examine these documents to become aware of locations where hazardous materials are present. Refer to Section 01 11 00 “Summary of Work” for requirements for coordination with the work of the Environmental Abatement Contractor.

1. Hazardous material remediation is specified in Section 02 82 13.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified in Section 02 82 13.

D. Carefully inspect the construction work area and items designated to be removed or preserved. Refer questions to the Architect before proceeding with the work.

E. Examine all adjoining work which may affect in any way selective demolition work.

F. Provide for and coordinate temporary utility services to existing building as indicated on the drawings or specified.

1. Location of existing fixtures, utility lines, ductwork, conduits, etc., shall be verified at the job site prior to start of demolition work.

G. Openings in wall, ceiling or floor construction assemblies discovered after removal of overlaying materials, or removal of mechanical, plumbing, electrical, fire suppression equipment or systems, shall be infilled with like construction materials to completely enclose and seal openings.

H. If removal of an item is required for access to work to be selectively demolished, that item shall be removed, protected, maintained int its original condition, and reinstalled in the work, unless otherwise noted.

I. Where removal of plumbing, HVAC, fire protection, electrical, communications systems or components results in openings left in existing floor, wall, or ceiling construction which is to remain, patch these openings in accordance with Section 01 73 00 – Cutting and Patching.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped in accordance with drawing notes.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs.

1. Comply with requirements specified in Section 01 32 33 – Photographic Documentation.
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

D. Perform survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

3.02 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain if any, and protect them against damage during selective demolition operations.

B. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

C. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utilities and mechanical/electrical systems serving areas to be selectively demolished in accordance with drawing.

1. Arrange to shut off indicated utilities with utility companies as required.
2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services. Systems that bypass area of selective demolition and that maintain continuity of service to other parts of building.
3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

3.03 PROTECTION REQUIREMENTS

A. Selective Demolition Protection Procedures:

1. Provide protective measures required by this specification in excess of those requirements for temporary protection specified under Section 01 50 00 – Temporary Facilities and Controls.
2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished, and adjacent facilities or work to remain. Ensure safe passage around areas of demolition. Prevent injury to adjacent facilities. Erect temporary covered passageways as required by authorities having jurisdiction.
3. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
4. Remove temporary protections required by this section at completion of selective demolition work.

B. Protect, support and maintain all conduits, drains, sewers, pipes, and wires to remain and which are subject to damage by construction activities.

1. Notify Architect if wires, conduits, pipes or other utilities serving building functions will be affected by demolition or remodeling before commencing such operations.
2. Disconnect and cap pipes and utilities as required and as necessary for demolition and alteration work.
3. Identify and indicate capping locations on Project Record Documents.

C. Provide protection for existing building surfaces and building components such that there is no possibility of damage to same, from demolition operations caused by impact, nicking, scratching, staining, or spillage of materials.

D. The protection system selected shall not be anchored to existing building finish surfaces or building components.

E. Protect items to be reused and relocated in construction. Refer to drawing notes.

F. Protection of Existing Surfaces:

1. Provide at minimum, protection levels specified in Section 01 50 00 – Temporary Facilities and Controls.
2. When removing portions of walls, partitions, or other vertical construction, or portions of vertical construction which is not to be totally demolished, provide floor covering protection on both sides of construction being demolished a distance of at least 4 feet or to the adjacent wall, whichever is the lesser distance.

3.04 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Construction Manager and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
3. Protect existing site improvements, appurtenances, and landscaping to remain.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
3. Cover and protect furniture, furnishings, and equipment that have not been removed.
4. Existing Facilities: Comply with specification requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 – Temporary Facilities and Controls.

C. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.05 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Do not use power driven impact tools. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Remove all hangers, supports, miscellaneous framing and similar items used to support work to be demolished and removed.

C. Removed and Salvaged Items: Comply with the following:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to authorized storage are.
4. Protect items from damage during transport and storage.
5. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
6. Pack or crate items after cleaning and repairing. Identify contents of containers.
7. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Prepare for reuse, clean, repair, refurbish, refinish or modify as indicated elsewhere in the Contract Documents.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations, or in locations indicated, after selective demolition operations are complete.

3.06 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Refer to Section 01 73 29 – Cutting and Patching for additional direction.

B. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

D. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

E. Roofing: Remove no more existing roofing than can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Refer to Division 07 Section "Preparation for Re-roofing" and other roofing related sections for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.07 DISPOSITION OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent. As work progresses, remove from site and legally dispose of all materials, products and debris removed during demolition work and not scheduled to be either salvaged or re-used.

B. Clean interior and exterior areas used for removal routes of debris.

C. Remove temporary work related to selective demolition operations upon completion of the work.

D. Upon completion of work, leave premises clean, neat and orderly and acceptable to the Architect.

3.08 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 031000

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Shoring, bracing, and anchoring.

B. Related Requirements:

1. Section 33000 "Cast-in-Place Concrete" for embedded items and surface finishes related to formwork.
2. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.
3. Section 321316 "Decorative Concrete Paving" for formwork related to decorative concrete pavement and walks.

1.02 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction, movement, contraction, and isolation joints
c. Forms and form-removal limitations.
d. Shoring and reshoring procedures.
e. Anchor rod and anchorage device installation tolerances.

1.04 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Forms for cylindrical columns.
4. Void forms.
5. Form ties.
6. Waterstops.
7. Form-release agent.

B. Sustainable Design Submittals:

1. See Section 01... for requirments.

C. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. See General Notes in Construction Documents for additional requirements.
2. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

D. Samples:

1. For waterstops.

1.05 INFORMATIONAL SUBMITTALS

A. Minutes of preinstallation conference.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

2.02 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

a. Plywood, metal, or other approved panel materials.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces not exceeding specified formwork surface class.

1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

2.03 WATERSTOPS

A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Williams Products, Inc.
b. .

2. Profile: Flat dumbbell with center bulb Flat dumbbell without center bulb Ribbed with center bulb Ribbed without center bulb.
3. Dimensions: 4 inches by 3/16 inch thick 6 inches by 3/8 inch thick 9 inches by 3/8 inch thick Insert dimensions; nontapered.

B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals, with factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. JP Specialties, Inc.
b. Sika Corporation.
c. Insert manufacturer's name.

2. Profile: Flat dumbbell with center bulb Flat dumbbell without center bulb Ribbed with center bulb Ribbed without center bulb Insert profile.
3. Dimensions: 4 inches by 3/16 inch thick 6 inches by 3/16 inch thick 6 inches by 3/8 inch thick 9 inches by 3/16 inch thick 9 inches by 3/8 inch thick Insert dimensions; nontapered.

C. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. BoMetals, Inc.
    b. Sika Corporation.
    c. Vinylex Waterstop & Accessories.
    d. Insert manufacturer's name.

2. Profile: Flat dumbbell with center bulb Flat dumbbell without center bulb Ribbed with center bulb Ribbed without center bulb Insert profile.
3. Dimensions: 4 inches by 3/16 inch thick 6 inches by 3/8 inch thick 9 inches by 3/8 inch thick Insert dimensions; nontapered.

D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. Carlisle Coatings & Waterproofing Inc.
    b. CETCO, a Minerals Technologies company.
    c. Concrete Sealants Inc.
    d. Henry Company.
    e. JP Specialties, Inc.
    f. Sika Corporation.
    g. Insert manufacturer's name.

E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. Adeka Corporation.
    b. CETCO, a Minerals Technologies company.
    c. GCP Applied Technologies Inc.
    d. Kryton International Inc.
    e. Sika Corporation.
    f. Insert manufacturer's name.

2.04 RELATED MATERIALS

A. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners shall be acceptable to form liner manufacturer.

F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.01 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes .

C. Limit concrete surface irregularities as follows:

1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

I. [**Chamfer**] [**Do not chamfer**] exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

    a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls [**as indicated on Drawings**] <**Insert spacing**>.

    a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

3.03 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
4. Secure waterstops in correct position at 12 inches on center.
5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.

    a. Miter corners, intersections, and directional changes in waterstops.
    b. Align center bulbs.

6. Clean waterstops immediately prior to placement of concrete.
7. Support and protect exposed waterstops during progress of the Work.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

3.04 INSTALLATION OF INSULATING CONCRETE FORMS

A. Comply with ACI 301 and manufacturer's instructions.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Install forms in running bond pattern.

1. Align joints.
2. Align furring strips.

D. Construct forms tight to prevent loss of concrete mortar.

E. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

I. Shore insulating concrete forms to ensure stability and to resist stressing imposed by construction loads.

3.05 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for [**24**] <**Insert number**> hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. For beam soffits, joists, slabs, and other structural elements that support weight of concrete see General Notes for formwork removal information.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.06 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.07 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. See Construction Documents for special inspection requirements.

END OF SECTION

SECTION 032000

CONCRETE REINFORCING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for reinforcing, hot weather fogging, calcium chloride, examination of reinforcing, vapor retarder protection, construction joints, concrete placement, position of reinforcing on chairs and repairs.
2. Section 033816 "Unbonded Post-Tensioned Concrete" for reinforcing related to post-tensioned concrete.
3. Section 034100 "Precast Structural Concrete" for reinforcing used in precast structural concrete.
4. Section 034500 "Precast Architectural Concrete" for reinforcing used in precast architectural concrete.
5. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.
6. Section 321316 "Decorative Concrete Paving" for reinforcing related to decorative concrete pavement and walks.

1.02 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction contraction and isolation joints.
c. Steel-reinforcement installation.

1.03 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Epoxy repair coating.
3. Zinc repair material.
4. Bar supports.
5. Mechanical splice couplers.
6. Structural thermal break insulated connection system.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
3. Environmental Product Declaration (EPD): For each product.
4. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
5. Environmental Product Declaration: For each product.
6. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
7. Environmental Product Declaration: For each product.
8. Environmental Product Declaration: For each product.
9. Third-Party Certifications: For each product.
10. Third-Party Certified Life Cycle Assessment: For each product.
11. Type III Environmental Product Declaration (EPD): For each product.
12. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
13. Manufacturer Inventory: For each product, provide manufacturer's manifest of ingredients.

C. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.

D. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect.

1.04 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.

B. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

C. Field quality-control reports.

D. Minutes of preinstallation conference.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.01 STEEL REINFORCEMENT

A. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.

1. Regional Materials: Steel shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
2. Regional Materials: Steel shall be manufactured within 500 miles of Project site.
3. Regional Materials: Steel shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
4. Indigenous Materials: Steel shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.
5. Regional Materials: Steel shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

C. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.

D. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60 ASTM A615/A615M, Grade 40 ASTM A706/A706M, deformed bars, assembled with clips.

E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

F. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.02 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

C. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced; mechanical-lap type.

D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain Galvanized ASTM A884/A884M, Class A, Type 1, epoxy coated, with less than 2 percent damaged coating in each 12-inch wire length.

2.03 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.01 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.02 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.
3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

    a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.03 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.04 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.05 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

1. See Contract Documents for special inspections.

END OF SECTION

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
4. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.02 DEFINITIONS

A. Cementitious Materials: Portland or Portland-Limestone cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.
e. Special concrete finish Subcontractor.

2. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction joints, control joints, isolation joints, and joint-filler strips.
c. Semirigid joint fillers.
d. Vapor-retarder installation.
e. Anchor rod and anchorage device installation tolerances.
f. Cold and hot weather concreting procedures.
g. Concrete finishes and finishing.
h. Curing procedures.
i. Forms and form-removal limitations.

j. Methods for achieving specified floor and slab flatness and levelness.
k. Floor and slab flatness and levelness measurements.
l. Concrete repair procedures.
m. Concrete protection.
n. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
o. Protection of field cured field test cylinders.

1.04 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Portland-limestone cement.
3. Fly ash.
4. Slag cement.
5. Aggregates.
6. Admixtures:

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

7. Vapor retarders.
8. Floor and slab treatments.
9. Curing materials.

    a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.

10. Joint fillers.
11. Repair materials.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
3. Environmental Product Declaration (EPD): For each product.
4. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
5. Environmental Product Declaration: For each product.
6. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
7. Environmental Product Declaration: For each product.
8. Environmental Product Declaration: For each product.
9. Third-Party Certifications: For each product.
10. Third-Party Certified Life Cycle Assessment: For each product.
11. Laboratory Test Reports: For [liquid floor treatments] [and] [curing and sealing compounds], indicating compliance with requirements for low-emitting materials.
12. Health Product Declaration (HPD): Provide documentation confirming product compliance with one of the following:

C. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Intended placement method.
11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Floor and slab treatments.
5. Bonding agents.
6. Vapor retarders.
7. Semirigid joint filler.
8. Joint-filler strips.
9. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.

2. Portland-Limestone cement.
3. Fly ash.
4. Slag cement.
5. Aggregates.
6. Admixtures:

D. Preconstruction Test Reports: For each mix design.

E. Field quality-control reports.

F. Minutes of preinstallation conference.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician [**with experience installing and finishing concrete, incorporating permeability-reducing admixtures**].

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

1.07 |PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.

1.08 |. DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.09 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.

1.10 Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.02 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 500 miles of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Regional Materials: Concrete shall be manufactured within 500 miles of Project site.

C. Regional Materials: Concrete shall be manufactured within 100 miles of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

D. Indigenous Materials: Concrete shall be manufactured within 500 miles of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.

E. Regional Materials: Concrete shall be manufactured within 500 miles of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.

F. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

G. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
2. Portland-Limestone Cement: ASTM C595, Type 1L.
3. Fly Ash: ASTM C618, Class C or F.
4. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

H. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.

c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.

2. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

I. Air-Entraining Admixture: ASTM C260/C260M.

J. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

K. Water and Water Used to Make Ice: ASTM C94/C94M, potable or

2.03 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A[**, except with maximum water-vapor permeance of**] <**Insert rating**>; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Reef Industries, Inc.
b. Stego Industries, LLC.
c. W.R. Meadows, Inc.
d. <Insert manufacturer's name>.

B. Sheet Vapor Retarder, Class C: ASTM E1745, Class C[, except with maximum water-vapor permeance of] <Insert rating>; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. Stego Industries, LLC.
   b. Tex-Trude.
   c. <Insert manufacturer's name>.

C. Sheet Vapor Retarder/Termite Barrier: ASTM E1745, Class A, except with maximum water-vapor permeance of 0.03 perms; complying with ICC AC380. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Polyguard Products, Inc.

2. Low-Temperature Flexibility: Pass at minus 15 deg F; ASTM D146/D146M.
3. Puncture Resistance: 224 lbf minimum; ASTM E154/E154M.
4. Water Absorption: 0.1 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D570.
5. Hydrostatic-Head Resistance: 231 feet minimum; ASTM D5385.

D. Bituminous Vapor Retarder: ASTM E1993/E1993M, 110-mil- thick, semiflexible, seven-ply sheet membrane, consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weather coating, and removable plastic release liner. Furnish manufacturer's accessories, including bonding asphalt, pointing mastics, and self-adhering joint tape.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

2. Water-Vapor Permeance: 0.0011 grains/h x sq. ft. x inches Hg when tested in accordance with ASTM E154/E154M.
3. Tensile Strength: 156 lbf/inch when tested in accordance with ASTM E154/E154M.
4. Puncture Resistance: 140 lbf when tested in accordance with ASTM E154/E154M.

2.04 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing [3/8-inch] [No. 4] [No. 8] <Insert size or gradation> sieve.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. Anti-Hydro International, Inc.
    b. Laticrete International, Inc.
    c. Metalcrete Industries.
    d. <Insert manufacturer's name>.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. Anti-Hydro International, Inc.
    b. Laticrete International, Inc.
    c. Master Builders Solutions.
    d. <Insert manufacturer's name>.

C. Emery Dry-Shake Floor Hardener: [Pigmented] [Unpigmented], factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.

1. Color: [As indicated by manufacturer's designation] [Match Architect's sample] [As selected by Architect from manufacturer's full range].

D. Metallic Dry-Shake Floor Hardener: [Pigmented] [Unpigmented], factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.

1. Color: [As indicated by manufacturer's designation] [Match Architect's sample] [As selected by Architect from manufacturer's full range].

E. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Dayton Superior.
b. Euclid Chemical Company (The); an RPM company.
c. Kaufman Products, Inc.
d. Laticrete International, Inc.
e. Master Builders Solutions.
f. Metalcrete Industries.
g. SpecChem, LLC.
h. US MIX Co.
i. <Insert manufacturer's name>.

F. Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Anti-Hydro International, Inc.
b. Butterfield Color, Inc.
c. Dynamic Color Solutions, Inc.
d. Euclid Chemical Company (The); an RPM company.
e. H&C® Decorative Concrete Products; a brand of Sherwin-Williams Co.
f. Kaufman Products, Inc.
g. Lambert Corporation.
h. Master Builders Solutions.
i. Scofield, a Business Unit of Sika Corporation.
j. SpecChem, LLC.
k. <Insert manufacturer's name>.

2. Color: [As indicated by manufacturer's designation] [Match Architect's sample] [As selected by Architect from manufacturer's full range].

a. Curecrete Distribution Inc.
b. Laticrete International, Inc.
c. NewLook International, Inc.
d. Vexcon Chemicals Inc.

2.05 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. Bon Tool Co.
    b. Brickform; a division of Solomon Colors.
    c. ChemMasters, Inc.
    d. Dayton Superior.
    e. Euclid Chemical Company (The); an RPM company.
    f. Kaufman Products, Inc.
    g. Lambert Corporation.
    h. Laticrete International, Inc.
    i. Master Builders Solutions.
    j. Metalcrete Industries.
    k. Nox-Crete Products Group.
    l. Sika Corporation.
    m. SINAK Corporation.
    n. SpecChem, LLC.
    o. TK Products.
    p. Vexcon Chemicals Inc.
    q. W.R. Meadows, Inc.
    r. <Insert manufacturer's name>.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

    a. Ambient Temperature Below 50 deg F: Black.
    b. Ambient Temperature Above 85 deg F: White.

D. Curing Paper: 8-feet- wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.

    a. Fortifiber Building Systems Group.

E. Water: Potable or complying with ASTM C1602/C1602M.

F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. Anti-Hydro International, Inc.
    b. Dayton Superior.
    c. Euclid Chemical Company (The); an RPM company.
    d. Kaufman Products, Inc.
    e. Lambert Corporation.
    f. Laticrete International, Inc.
    g. Nox-Crete Products Group.
    h. SpecChem, LLC.
    i. TK Products.
    j. Vexcon Chemicals Inc.
    k. W.R. Meadows, Inc.
    l. <Insert manufacturer's name>.

G. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. ChemMasters, Inc.
    b. Concrete Sealers USA.
    c. Dayton Superior.
    d. Euclid Chemical Company (The); an RPM company.
    e. Kaufman Products, Inc.
    f. Lambert Corporation.
    g. Laticrete International, Inc.
    h. Metalcrete Industries.
    i. Nox-Crete Products Group.
    j. Right Pointe.
    k. SpecChem, LLC.
    l. TK Products.
    m. Vexcon Chemicals Inc.
    n. W.R. Meadows, Inc.
    o. <Insert manufacturer's name>.

2. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 16.5 mcg/cu. m or 13.5 ppb, whichever is less.
5. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
6. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.06 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: [ASTM D1751, asphalt-saturated cellulosic fiber] [or] [ASTM D1752, cork or self-expanding cork].

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, [epoxy resin with a Type A shore durometer hardness of 80] [aromatic polyurea with a Type A shore durometer hardness range of 90 to 95] in accordance with ASTM D2240.

C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

1. [Types I and II, nonload bearing] [Types IV and V, load bearing], for bonding hardened or freshly mixed concrete to hardened concrete.

E. Floor Slab Protective Covering: 8-feet- wide cellulose fabric.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. McTech Group, Inc.
    b. <Insert manufacturer's name>.

2.07 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than [4100 psi] <**Insert strength**> at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than [5000 psi] <**Insert strength**> at 28 days when tested in accordance with ASTM C109/C109M.

2.08 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement or portland-limestone cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Silica Fume: 10 percent by mass.
4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

D. See General Notes for Concrete Mixture Information.

2.09 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.03 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.04 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.05 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated.

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.06 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.07 FINISHING FORMED SURFACES

A. As-Cast Surace Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material .

    a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    b. Remove projections larger than 1 inch.
    c. Tie holes do not require patching.
    d. Surface Tolerance: ACI 117 Class D.
    e. Apply to concrete surfaces not exposed to public view and will not receive a coating or covering material applied directly to the concrete Insert locations.

2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/4 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class B.
    e. Locations: Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.08 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
3. Apply scratch finish to surfaces [**to receive concrete floor toppings**] [**to receive mortar setting beds for bonded cementitious floor finishes**] <**Insert locations**>.

C. Float Finish :

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

D. Trowel Finish :

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

    a. Slabs on Ground:

        1) Specified overall values of flatness, F_F 25; and of levelness, F_L 20; with minimum local values of flatness, F_F 15; and of levelness, F_L 12.
        2) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 21; and of levelness, F_L 15.
        3) Specified overall values of flatness, F_F 45; and of levelness, F_L 35; with minimum local values of flatness, F_F 27; and of levelness, F_L 21.
        4) Specified overall values of flatness, F_F 50; and of levelness, F_L 25; with minimum local values of flatness, F_F 30; and of levelness, F_L 15.

    b. Suspended Slabs:

        1) Specified overall values of flatness, F_F 25; with minimum local values of flatness, F_F 15.
        2) Specified overall values of flatness, F_F 35; with minimum local values of flatness, F_F 21.
        3) Specified overall values of flatness, FF 45; with minimum local values of flatness, FF 27.

E. Broom Finish : Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

F. Slip-Resistive Finish: Before final floating, apply slip-resistive [aggregate] [aluminum granule] finish to concrete stair treads, platforms, ramps as indicated on Drawings

1. Apply in accordance with manufacturer's written instructions and as follows:

    a. Uniformly spread [25 lb/100 sq. ft.] <**Insert rate**> of dampened slip-resistive [aggregate] [aluminum granules] over surface in one or two applications.
    b. Tamp aggregate flush with surface, but do not force below surface.
    c. After broadcasting and tamping, apply float finish.
    d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive [aggregate] [aluminum granules].

G. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of [100 lb/100 sq. ft.] <**Insert rate**> unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating.
3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
4. After final floating, apply a trowel finish.
5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.09 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.10 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.

2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.
        2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

    a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

        1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

            a) Lap edges and ends of absorptive cover not less than 12 inches.
            b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

        2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

            a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
            b) Cure for not less than seven days.

        3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

            a) Water.
            b) Continuous water-fog spray.

    b. Floors to Receive Curing Compound:

        1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
        2) Recoat areas subjected to heavy rainfall within three hours after initial application.
        3) Maintain continuity of coating, and repair damage during curing period.
        4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

    c. Floors to Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

A. Conform to ACI 117.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least [**one**] [**six**] month(s).
2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

a. Limit cut depth to 3/4 inch.
b. Make edges of cuts perpendicular to concrete surface.
c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
d. Fill and compact with patching mortar before bonding agent has dried.
e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

    a. Correct low and high areas.
    b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

    a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

    a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
    b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.

    a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
    b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

    a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    d. Place, compact, and finish to blend with adjacent finished concrete.
    e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

    a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    b. Dampen cleaned concrete surfaces and apply bonding agent.
    c. Place patching mortar before bonding agent has dried.
    d. Compact patching mortar and finish to match adjacent concrete.
    e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

1) Project name.
2) Name of testing agency.
3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
4) Name of concrete manufacturer.
5) Date and time of inspection, sampling, and field testing.
6) Date and time of concrete placement.
7) Location in Work of concrete represented by samples.
8) Date and time sample was obtained.
9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results.
13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

1. See Contract Documents for Special Inspections.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; [**ASTM C173/C173M volumetric method, for structural lightweight concrete**].

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and laboratory cure four 6-inch by 12-inch or five 4-inch by 8-inch cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M.

    a. Test one laboratory-cured specimen at seven days and one set of two 6-inch by 12-inch or three 4-inch by 8-inch specimens at 28 days. Hold one speciman for additional testing if required.
    b. A compressive-strength test to be the average compressive strength from a set of two 6-inch by 12-inch or three 4-inch by 8-inch specimens obtained from same composite sample and tested at age indicated.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
9. Additional Tests:

    a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

        1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.15 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION

SECTION 04 21 13

BRICK UNIT MASONRY

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes unit masonry assemblies which include face brick including the following:

1. Face brick
2. Mortar and grout.
3. Ties and anchors.
4. Embedded flashing.
5. Miscellaneous masonry accessories.

B. Related Sections:

1. Structural Notes on drawings.
2. Section 04 22 00 – Concrete Unit Masonry
3. Section 05 50 00 – Metal Fabrications: Placement of loose steel lintels and steel anchors for bearing plates.

1.02 REFERENCES

A. ASTM C 216 – Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)

B. ASTM C270 – Standard Specification for Mortar for Unit Masonry

1.03 ACTION SUBMITTALS

A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

D. Samples for Verification: For each type and color of the following:

1. Face brick in the form of straps of five or more bricks.
2. Mortar. Make Samples using same sand and mortar ingredients to be used on Project.
3. Flashing. Minimum sample size 10 inches square.
4. Proposed Pointing Mortar: Submit 5 inch square or 5 inch diameter sample for each type and color of exposed mortar required, for approval of color and texture.

    a. Have each set contain a close color range of at least three Samples of different mixes of colored sands and cements that produce a mortar matching the existing mortar when cured and dry
    b. Reformulate and resubmit until match is approved by Architect.

1.04 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include data on material properties indicating compliance with specifications.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence according to ASTM C 67.
d. For surface-coated brick, include test report for durability of surface appearance after 50-cycles of freezing and thawing per ASTM C 67 or a list of addresses of buildings in Project's area where proposed brick has been used successfully and with a history of durability.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Anchors, ties, and metal accessories.

C. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.05 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate

C. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified:

1. ACI 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures except as otherwise indicated

D. Methods and Workmanship: In accordance with NCMA TEK Bulletins unless otherwise specified herein.

1.06 MOCK-UP

A. Sample Panel: Before starting work, build one sample panel for inspection and approval to verify selections made under sample submittals and to demonstrate aesthetic effects as well as other qualities of materials and execution. Build panel on a firm foundation, in location indicated by the Architect. Build mock-ups to comply with the following requirements, using materials indicated for final unit of Work.

1. Panel shall be F-shaped, with long side a minimum of 5 feet 4 inches long by 3 feet 4 inches high, with one corner return at least 2 feet long.
2. Construct long side and return of 8 inch concrete block and face brick. Panel shall show color range and texture of masonry units, bond, mortar joints, and workmanship.
3. Include specified masonry units, mortar and accessories and using materials, bond and joint tooling required for the work. Completed masonry work in the building shall be equal to that shown in the approved panel. Do not remove panel until masonry work is completed or until removal is authorized.
4. Acceptance of mock-ups is for color, texture, and blending of masonry units; relationship of mortar and sealant to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other materials and construction qualities.

B. Obtain Architect’s acceptance of the mock-ups before start of masonry work. When accepted, mock-ups will demonstrate minimum standard for the work. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing. Do not remove panels until masonry work is completed or until removal is authorized by the Architect.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store masonry in a dry place, off the ground on prepared platforms in a manner to promote air circulation through and around units.

1. Carefully stack all masonry units, and protect with shed or tarpaulin.
2. Protect anchors, ties, and reinforcement from elements.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Handle all masonry units carefully at all times. Do not build units with chipped edges, spalls, or other damage to their appearance into the work.

1.08 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 – PRODUCTS

2.01 MASONRY UNITS – GENERAL

A. Manufacturer: Obtain masonry units from one manufacturer of uniform texture and color for each kind required, for each continuous area and visually related areas.

B. Comply with referenced unit masonry standard and other requirements specified in this Section applicable to each material indicated.

C. Match Existing Masonry Veneer: Wherever "match existing" indicated, provide masonry veneer units of matching color, texture, and size as existing adjacent masonry veneer work. Approval of masonry will be verified by mockups.

2.02 BRICK MASONRY

A. General: Provide shapes indicated and as follows for each form of brick required.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.

3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: Facing brick complying with ASTM C 216:

1. Basis of Design Manufacturer/Product: Subject to compliance with requirements, provide the following:

   a. Facing brick as manufactured by Endicott Clay Products Co., Endicott, NE, "Manganese Ironspot Velour."

2. Grade: SW.
3. Type: FBX
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.
7. Norman Size (Actual Dimensions): Modular size, 3-5/8 inches wide by 2-1/4 inches high by 11-5/8 inches long.

2.03 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Davis Colors; True Tone Mortar Colors.
   b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
   c. Solomon Colors, Inc.; SGS Mortar Colors.

E. Colored Cement Product: Packaged blend made from portland cement and hydrated lime mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:

   a. Products: Subject to compliance with requirements, provide products from one of the following:

      1) Argos USA: Magnolia Eaglebond Portland Lime
      2) Cemex: Portland Cement-Lime Mix
      3) Essroc: Flamingo Brixment Colored Masonry Cement
      4) Lafarge North America: Eaglebond Portland and Lime
      5) Lehigh Hanson: HeidelbergCement Group; Lehigh Custom Color Portland/Lime Cement.

2. Pigments shall not exceed 10 percent of portland cement by weight.

3. Pigments shall not exceed 5 percent of mortar cement by weight.

2.04 PREMIX MORTARS

A. Portland Cement-Lime Mix: Packaged blend of Portland cement complying with ASTM C150, Type I or III, and hydrated lime complying with ASTM C207, Type S.

B. Masonry Cement: ASTM C 91/C 91M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Argos USA: Magnolia Cement
b. Cemex: Masonry Cement
c. Essroc: Brixment Masonry Cement
d. Lafarge North America: Masonry Cement
e. Lehigh Hanson; HeidelbergCement Group: Cement-lime Masonry Cement.

C. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

D. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

2.05 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.

2.06 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Copper: ASTM B 370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. weight or 0.0216 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall flashing with drip edge between brick and concrete foundation unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

B. Solder and Sealants for Sheet Metal Flashings

1. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
2. Elastomeric Sealant: ASTM C 920, chemically sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.07 WEEP/VENT MATERIALS

A. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard:

1. Advanced Building Products Inc.; Mortar Maze weep vent.
2. Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
3. Heckmann Building Products Inc.; No. 85 Cell Vent.
4. Hohmann & Barnard, Inc.; Quadro-Vent.
5. Wire-Bond; Cell Vent.

B. Cavity Vent Products: Use the following, unless otherwise indicated:

1. Aluminum Weep Hole/Vent: One-piece, L-shaped units made from sheet aluminum, designed to fit into a head joint and consisting of a vertical channel with louvers stamped in web and with a top flap to keep mortar out of the head joint; painted before installation to comply with Section 09 91 00 in color approved by Architect to match that of mortar.

a. Product: Hohmann & Barnard, Inc.; #343W.
b. Wilko Weep Hole.

2.08 MASONRY ACCESSORY MATERIALS

A. Preformed Control-Joint Gaskets: Styrene butadiene rubber compound conforming to ASTM D2000, Designation M2AA-805, regular design to fit standard sash block, with a durometer hardness of 80 when tested in accordance with ASTM D2240.

1. Manufacturer:

a. Dur-O-Wal "Rapid Control Joint,
b. AA Wire Products “AA1000 Titewall,
c. or approved equal.

B. Compressible Filler: Premolded filler strips complying with ASTM D1056, Type 2, Class A, Grade 1; closed cell neoprene; compressible up to 35 percent; of width and thickness indicated.

1. Manufacturer:

a. Dur-O-Wal Rapid® Soft-Joint/Expansion Joint.
b. AA3405 Joint-Tite of AA Wire Products.
c. Hohmann & Barnard, Inc. #NS Closed Cell Neoprene Sponge.

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Provide one of the following configurations:

a. Strips, full-depth of cavity and 10 inches wide, with shaped surface that catch mortar, and prevent cavity from being clogged with mortar droppings.

2. Manufacturer/Products:

a. Mortar Net USA, Ltd.; Mortar Net.
b. Archovations, Inc.; CavClear Masonry Mat
c. Advanced Building Products Inc.; Mortar Break

2.09 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar.
2. Use portland cement-lime mortar cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide Type N unless another type is indicated.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of mortar cement by weight.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:

a. Face brick.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match approved mockup.
2. Application: Use colored aggregate mortar for exposed mortar joints with the following units:

a. Concrete facing brick.
b. Face brick.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove dirt, ice, loose rust, and scale from metal components prior to installation.

B. Protect base of exterior walls from splattering of mortar, soil, mud and other materials that might stain the masonry up to 4 feet above grade with a membrane similar to 45 mil EPDM or plywood sheathing material. Maintain protection for the entire duration of the project.

C. Protect all sills, ledges, and projections from droppings of mortar. Protect door jambs and corners from damage during masonry construction.

D. Verify that initial rate of absorption of brick is less than 1 gram per square inch per minute. Brick with absorption rates in excess of this amount shall be wetted with clean water 24 hours prior to placement until units are nearly saturated, and shall be surface dry when laid. During freezing weather, sprinkle units that require wetting with warm or hot water just before placement.

E. Layout walls in advance to properly locate openings, movement type joints, returns and offsets. Avoid use of less than half-size units at corners, jambs, and other locations.

F. Direct and coordinate placement of metal anchors supplied by other sections.

G. Provide temporary bracing during the installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 INSTALLATION – GENERAL

A. Thickness: Build masonry construction to the full thickness shown, except, build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness shown or specified.

B. Build chases and recesses as shown and as required for the work of other trades. Provide not less than 8 inches of masonry between chases or recess and jamb of openings, and between adjacent chases and recesses.

C. As work progresses, build in metal frames, anchor bolts, bearing plates, reinforcement, inserts, sleeves and other items furnished by other sections. Form chases and openings required for other work.

D. Build in items plumb and level.

E. Build in work of other trades without weakening or defacing masonry.

F. Provide anchoring devices of the type indicated and specified for anchoring masonry work. Provide open space not less than 1/2 inch width between masonry and structural member. Keep space free of mortar or other materials.

G. Build composite walls and other masonry construction to the full thickness shown. Note rustication coursing.

H. Lay masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in first course on footings and foundation walls, and adjacent to cells or cavities to be filled with grout. Fill collar joints between wythes solid with mortar in exterior walls of multiple wythe construction.

I. Mix units for exposed brick infills areas from several pallets or cubes as they are placed to produce uniform blend of colors and textures.

J. Buttering corners of joints or excessive furrowing of mortar joints are not permitted. Remove excess mortar as work progresses.

K. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, after mortar has started to harden, remove mortar and replace with fresh mortar.

L. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

M. Leave openings for piping and vents which is to be installed later in construction. After installation of piping and vents, complete masonry work to match work adjacent to the openings.

N. Cut neatly around pipes and vents. Fill cracks with mortar.

O. Cut joints flush for masonry walls which are to be concealed, unless otherwise shown.

P. Rake out mortar in preparation for application of caulking or sealants where required.

3.04 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Lay up walls plumb and true within specified tolerances. Provide corners and angles square, with corners level. Coordinate with other work.

D. Lay face brick units in 1/3 running bond with vertical joint in each course offset 1/3 brick length on units in courses above and below. Provide coursing as indicated on drawings.

E. Form concave tooled mortar joints in all exposed work.

F. Compress and cut joints flush for masonry walls which are below grade, concealed, or covered by other materials.

G. Provide 3/8 inch joint widths, except for minor variations required to maintain bond alignment.

H. Stopping and Resuming Work: Stop horizontal runs at end of work day by racking back 1/2 unit length in each course, do not tooth. Clean exposed surfaces of set masonry, and remove loose masonry units and mortar prior to laying fresh masonry.

3.05 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

B. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.

C. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.

D. Locate anchor sections to allow maximum vertical differential movement of ties up and down.

E. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

3.06 LINTELS

A. Install loose steel lintels over window openings, door openings, and at other locations shown. Do not bond masonry work to bearing support ends of lintels.

B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.07 MASONRY FLASHINGS, WEEP HOLES, CAVIATY DRAINAGE AND VENTS

A. Do not begin installation until substrates have been properly prepared and sloped so that water will drain to building exterior.

B. Verify that surfaces to receive flashing are thoroughly dry, free from loose materials, and reasonably smooth, with no projections or sharp edges that could puncture flashing.

C. Install in accordance with manufacturer's instructions and with applicable recommendations of SMACNA Architectural Sheet Metal Manual.

1. Lap flashing joints minimum of 4 inches and seal watertight with mastic.
2. Carry flashing vertically as detailed, but in no case less than 6 inches above horizontal flashing plane.
3. Extend head and sill flashings not less than 6 inches beyond openings and turn up to form watertight pan; seal with mastic.

D. Masonry Flashing: Lay horizontal flashing in slurry of fresh mortar and top with fresh full bed of mortar to receive masonry units.

1. Carry flashing through wall and leave exposed for inspection.
2. After inspection and approval, cut flashing flush with surface of masonry or as otherwise detailed.
3. Remove mortar or other obstructions from weep holes.

E. Install flashing as follows:

1. At masonry-veneer walls, extend flashing from exterior face of veneer, through veneer, up face of sheathing at least 8 inches or where morter drainage material is used carry flashing up 8 inches higher than drainage material, and behind air-infiltration barrier or building paper.
2. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. At heads and sills, extend flashing 4 inches at ends and turn flashing up not less than 2 inches to form a pan.
3. Extend sheet metal flashing 1/2 inch beyond face of masonry at exterior and turn flashing down to form a drip.
4. Install metal drip edges beneath flashing at exterior face of wall. Stop flashing 1/2 inch back from outside face of wall and adhere flashing to top of metal drip edge.

F. Provide end dams at least 4 inches high where flashing is not continuous at wall openings, building expansion joints, and where masonry meets adjacent wall materials and systems. Install flashing in veneer walls carrying flashing up face of sheathing at least 8 inches and behind building felt paper. Bond and seal end dam flashing to wall flashing and seal end dam flashing against end brick.

G. Extend flashing continuous around corners. Cut, overlap and seal all corner flashing. Extend flashing continuous across vertical control joints. Lap flashing at joint a minimum of 6 inches and seal with joint sealant.

H. Install concealed flashing in accordance with BIA Technical Notes 7 and SMACNA "Architectural and Sheet Metal Manual" Plates 52 and 53. Extend flashings beyond edge of lintels and sills at least 4 inches. Extend flashing vertically at least 8 inches or where morter drainage material is used carry flashing up 8 inches higher than drainage material, and build into or anchor to back-up for a complete watertight installation. Seal top edge of flashing anchored to back-up sheathing and stud framing.

I. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:

1. Use round plastic tubing with wicking material to form weep holes.
2. Space weep holes 24 inches o.c.

J. Trim wicking material used in weep holes flush with outside face of wall after mortar has set.

K. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.08 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joints in unit masonry where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Install preformed control-joint gaskets designed to fit standard sash block.

C. Build in horizontal, pressure-relieving joints where indicated; construct joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 – Joint Sealants.

3.09 JOINT REINFORCEMENT

A. Provide continuous horizontal joint reinforcement in all unit masonry walls as follows:

1. Place continuous reinforcing spaced at 16 inches on center vertically, full height of wall and every block course shown on the drawings, except at control/expansion joints.
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 24 inches each side of opening.
3. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, pipe enclosures and other special conditions.
4. Install reinforcing steel and concrete grout specified in Section 03 30 00. Support and secure reinforcing bars from displacement. Comply with drawing details for steel size and spacing. Maintain position of reinforcing within 1/2 inch of dimensioned position.
5. Embed anchors attached to structural steel members and grout solid.

3.10 CAVITY WALLS

A. Lay wythes of cavity walls concurrently except where pintle and eye type horizontal joint reinforcing is shown. At no time shall a wythe be more than 16 inches higher than any other wythe being constructed concurrently.

B. Where pintle and eye joint reinforcement is shown, concrete masonry wythes may be laid up full height separate from facing wythe.

C. Keep cavity clean of mortar droppings by suspending by wires a wooden strip the width of the air space. Strip shall be lifted as each course of joint reinforcement is laid in facing wythe. Mortar shall be placed so that excess is not pressed into cavity air space as facing wythe is laid-up. Bevel mortar back from cavity face of brick to prevent mortar from being pressed into cavity as brick is tapped into position. Install cavity mortar protection in cavity above thru wall flashing and where indicated.

D. Tie exterior wythe to back-up with continuous horizontal joint reinforcing embedded in mortar joints at not more than 16 inches o.c. vertically.

E. Provide concealed flashing around entire perimeter at base of walls in first course above grade. Provide concealed flashing and cell vents above exterior wall openings and within exterior walls that project above adjacent lower roof(s); and at all locations shown on the drawings and at any other locations as required to complete the integrity of system. Install as specified hereinafter. Flashing joints shall be made by lapping a minimum of 4 inches and coating the contacting surfaces with mastic.

F. Fill all cracks and open gaps in insulation with sealant.

G. Provide cell vent in exterior wythe of cavity wall located immediately above ledges and flashing spaced 24 inches o.c., unless otherwise shown.

H. Provide sheet metal flashing drip for elastomeric flashing.

I. Maintain cavities/air spaces clean of mortar droppings and other materials during construction.

J. Tie exterior wythe to metal framing backup with individual metal ties. Stagger alternate courses.

K. Install weeps horizontally in head joint at first course of exterior masonry wythe immediately above flashing. Space weeps at 24 inches on center horizontally. Extend cord weeps vertically up the face of the flashing to within 1 inch of the top edge.

L. Install weep ventilators at 24 inches on center in the head joint below metal coping, at the top of masonry veneer wall assemblies with steel stud back up.

3.11 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, and sleeves. Coordinate with other Sections of work to provide correct size, shape, and location.

B. Obtain Architect's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace units which are loose, chipped, broken, stained, or otherwise damaged. Provide new masonry units to match adjoining units and install in fresh mortar pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in "BIA Technical Notes 20."
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

E. Clean walls at a time which will permit a thorough cleaning without damage to any other finished surfaces. Clean soiled surfaces with cleaning solution.

END OF SECTION

SECTION 04 22 00

CONCRETE UNIT MASONRY

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes providing reinforced concrete unit masonry construction for exterior and interior walls and including:

1. Mortar and grout
2. Steel reinforcing bars, ties, anchors, and other metal accessories, for anchoring unit masonry together and to other materials.
3. Masonry joint reinforcement.
4. Compressible joint fillers for control joints in unit masonry work and joints with structural steel.
5. Water management flashing and weeps
6. Control joints in concrete masonry.

B. Place, install and build-in, as work progresses, the following products and materials furnished under the indicated Sections:

1. Anchor bolts, wood blocking, and anchorage items furnished or set by other trades as specified in individual Sections.

C. Concrete unit masonry work including but not limited to the following:

1. Reinforced concrete unit masonry walls.
2. Exterior back-up walls for exterior wall masonry veneer facing.
3. Interior partitions

D. Work installed under this Section, but materials or products furnished under the following Divisions or Sections:

1. Section 04 21 13 – Brick Unit Masonry.
2. Section 03 30 00 – Cast-In-Place Concrete
3. Division 5 Sections:

   a. Installation of anchor bolts, bearing plates and loose steel angle lintels furnished under Section 05 12 00 – Structural Metal Framing: Anchor bolts, steel plates, and steel lintels.
   b. Installation of loose lintels indicated on the Drawings shall be included under the Work of this Section.

4. Section 06 10 00 – Rough Carpentry: For wood bucks and nailing blocks.
5. Section 08 11 00 – Metal Doors and Frames.

1.02 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.03 SYSTEM PERFORMANCE REQUIREMENTS

A. Compressive Strength: Provide unit masonry that develops a minimum installed design compressive strength f'm with special inspection of 1,500 psi. Develop the compressive strength of masonry by meeting the minimum unit and mortar strengths specified in the documents or by prism testing in accordance with ASTM C1314.

1.04 REFERENCE STANDARDS

A. The latest versions of the publications listed below form a part of this specification; comply with provisions of these publications except as otherwise shown or specified.

1. ACI 530.ASCE 5/TMS402: Building Code Requirements for Masonry Structures
2. ACI 530.1/ASCE6/TMS602: Specifications for Masonry Structures

B. Concrete Unit Masonry Construction: Comply with National Concrete Masonry Association (NCMA) “TEK Bulletins” and as specified.

1. NCMA TEK Bulletin 03-01C "All-Weather Concrete Masonry Construction"
2. NCMA TEK Bulletin 03-02A "Grouting Concrete Masonry Walls."
3. NCMA TEK Bulletin 07-01D “Fire Resistance Rating of Concrete Masonry Assemblies”

1.05 INFORMATIONAL SUBMITTALS

A. Prepare submittals in accordance with Section 01 30 00 – Submittal Procedures for submittal requirements.

B. Information and Review Submittals:

1. Literature: Manufacturer’s product data sheets, specifications, performance data, physical properties for each item furnished hereunder.
2. Material certificates: Provide for the following, signed by manufacturer and Contractor certifying that each material complies with requirements.

    a. Each different cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
    b. Each material and grade indicated for reinforcing bars.
    c. Each type and size of joint reinforcement.
    d. Each type and size of anchors, ties, and metal accessories.

3. Material test reports from a qualified independent laboratory employed and paid by Contractor indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements indicated:

    a. Mortar complying with the property requirements of, and tested in accordance with ASTM C 270.
    b. Mortar complying with the proportion requirements of ASTM C 270 and tested in accordance with ASTM C 780.
    c. Grout mixes: Include description of type and proportions of grout ingredients.
    d. Masonry units; report for tests performed within the previous six months.

4. Shop drawings:

    a. Provide elevations of masonry work showing jointing patterns and coursing; indicate locations of expansion and control joints.

1.06 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified:

1. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
2. ASTM C 140-02: **T**est Methods for Sampling and Testing Concrete Masonry Units and Related Units.

B. Concrete Unit Masonry Construction: Comply with National Concrete Masonry Association (NCMA) “TEK Bulletins” and as specified.

1. NCMA TEK Bulletin 03-02A "Grouting Concrete Masonry Walls."
2. NCMA TEK Bulletin 07-01D “Fire Resistance Rating of Concrete Masonry Assemblies.”

C. Obtain masonry units from a single manufacturing source to assure uniform texture and color, for each type required, for each continuous area and visually related areas.

D. Unit Masonry Producer Qualifications: Producer shall be a member in good standing of the National Concrete Masonry Association (NCMA).

E. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

F. Fire Performance Characteristics: Where indicated, provide materials and construction identical to those of assemblies whose fire resistance has been determined in accordance with ASTM E119 by a testing and inspecting organization, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

G. Consult other trades and make provisions to permit installation of their work in a manner to avoid cutting and patching. Build in work specified under other Sections, as necessary, and as work progresses.

1.07 MOCK-UP

A. Prior to installing unit masonry, construct sample wall panels to verify selections made under sample submittals and to demonstrate aesthetic effects as well as other qualities of materials and execution. Build mock-ups to comply with the following requirements, using materials indicated for final unit of Work.

B. Build mock-ups for the following types of masonry in sizes approximately 48 inches long by 48 inches high by full thickness, including face and back-up wythes as well as accessories.

1. Provide sample panel mock-ups of each type of masonry to be used as an exterior facing in the work.
2. Panel shall be F-shaped, with long side a minimum of 5 feet 4 inches long by 3 feet 4 inches high, with one corner return at least 2 feet long and with one intersecting 6 inch thick concrete block wall 2 feet long.
3. Construct long side and return of 8 inch concrete block and face brick. Panel shall show color range and texture of masonry units, bond, mortar joints, and installation.
4. Include specified masonry units, mortar and accessories and using materials, bond and joint tooling required for the work. Panel shall indicate color range and texture of masonry units, bond, mortar joints, and installation proposed for the completed work.
5. Acceptance of mock-ups is for color, texture, and blending of masonry units; relationship of mortar and sealant to masonry unit colors; tooling of joints; aesthetic qualities of installation; and other materials and construction qualities.

C. Obtain Architect’s acceptance of the mock-ups before start of masonry work. When accepted, mock-ups will demonstrate minimum standard for the work. Do not remove panels until masonry work is completed or until removal is authorized by the Architect.

1.08 PRE-INSTALLATION CONFERENCE

A. Prior to the installation of the masonry and associated work, meet at the project site with the installer, the installer of each component of associated work, the installers of other work in and around masonry (including windows), the Architect and other representatives directly concerned with performance of the Work, including (where applicable) insurers, test agencies, product manufacturers, governing authorities, and the Owner. Record (by masonry contractor) the discussions of the conference and the decisions and agreements (or disagreements) reached and furnish a copy of the record to each party attending. Review foreseeable methods and procedures related to the masonry work, including, but not necessarily limited to, the following.

1. Review project requirements (Drawings, Specifications, and other Contract Documents), including sample panels, job mock-ups, and cleaning procedures.
2. Review required submittals, both completed and yet to be completed.
3. Review status of substrate work, including drying, structural loading limitations, and similar considerations.
4. Review availability of materials, tradesmen, equipment, and facilities needed to make progress and avoid delays.
5. Review required observation, testing, certifying, and accounting procedures.
6. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions, including the possibility of temporary enclosures.
7. Review regulations concerning code compliance, environmental protection, health, safety, fire, and similar considerations.
8. Review procedures needed for protection of masonry during the remainder of the construction period.
9. Consider each party's expert judgment, as advanced in the interest of successful completion of the work.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project Site in manufacturer's original and unopened containers and packaging, bearing labels as to type and names of products and manufacturers.

B. Protect grout, mortar, and other materials from deterioration by moisture and temperature. Store in a dry place or in waterproof containers. Keep containers tightly closed and away from open flames. Protect liquid components from freezing.

C. Store masonry in a dry place, off the ground on prepared platforms in a manner to promote air circulation through and around units.

1. Carefully stack all masonry units, and protect with shed or tarpaulin.
2. Protect anchors, ties, and reinforcement from elements.
3. Protect concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.

D. Handle all masonry units carefully at all times. Do not build units with chipped edges, spalls, or other damage to their appearance into the work.

1.10 PROJECT CONDITIONS

A. Protect partially completed masonry against weather, when Work is not in progress, by covering top of walls with strong, waterproof, nonstaining membrane. Extend membrane at least 2 foot down both sides of walls and anchor securely in place.

B. This structure is designed to be self-supporting and stable after the building is fully completed. Protect masonry walls against wind damage by bracing as required until support of walls is integral with the completed building structure. This includes the addition of whatever temporary bracing, guys, or tie-downs that might be necessary. Such material is not shown on the Drawings. If applied, they shall be removed as conditions permit, and shall remain the Contractor’s property.

C. Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry. Protect sills, ledges, and projections from mortar droppings.

D. Hot and Cold Weather Precautions: Comply with BIA Technical Notes 1A and NCMA TEK 03-01C requirements and the following:

1. Do not use frozen materials or materials mixed or coated with ice or frost.
2. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing.
3. Protect completed masonry work against freezing after laying.
4. Do not use metal reinforcements or anchors coated with loose rust or other coating, including ice, which will reduce or destroy bond.
5. Dry brush clean exposed masonry with bristle brushes at end of each day's work. Remove mortar spatters and joints ridges.

E. Masonry Construction Tolerances: Comply with masonry construction tolerances as required by ACI 530.1

F. Furnish and install all temporary bracing required to prevent damage or stress to masonry work by reason of wind or other loads which may be superimposed on the work. All bracing shall be rigid, secure, and solidly anchored against movement. Remove when no longer required. Be solely responsible for any damage incurred by failure to properly brace and protect against external forces.

1.11 EXTRA MATERIALS

A. Furnish, fabricate, and place, additional masonry reinforcement and grout in quantity indicated on structural drawings, as directed by the Architect.

PART 2 – PRODUCTS

2.01 MASONRY UNITS – GENERAL

A. Manufacturer: Obtain masonry units from one manufacturer of uniform texture and color for each kind required, for each continuous area and visually related areas.

B. Comply with referenced unit masonry standard and other requirements specified in this Section applicable to each material indicated.

C. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

1. One hour; D2 Class
2. Two hour; D2 Class
3. Three hour; C-3 Class

2.02 CONCRETE MASONRY UNITS

A. Concrete Masonry Units: All CMU on this project to have minimum compressive strength of 2100 net cross sectional area.

B. Concrete Masonry Units:

1. Manufacturer: Shall be a member of the National Concrete Masonry Association (NCMA).
2. Weight Classification: Normal weight.
3. Size: Manufactured to the actual dimensions listed below (within tolerances specified in the applicable referenced ASTM specification) for the corresponding nominal sizes indicated on the drawings.

    a. 4 inch nominal: 3-5/8 inch actual.
    b. 6 inch nominal: 5-5/8 inch actual.
    c. 8 inch nominal: 7-5/8 inch actual.
    d. 12 inch nominal: 11-5/8 inch actual.

4. Special Shapes: Provide, where shown and where required, lintels, corners, jambs, sash, control joints, headers, bond beams, bullnose, and other special conditions.
5. Exposed Face: Manufacturer's standard color and texture, unless otherwise indicated.
6. Fire Resistance: Furnish units with specified fire resistance classification, where indicated on Drawings, based on the equivalent thickness method to determine fire-resistance classification as published in the National Concrete Masonry Association's TEK 07-01D (Fire Resistance Rating of Concrete Masonry Assemblies).
7. Bond beam units shall be such that where two reinforcing steel bars are required in the bond beams, bars may be located not greater than 2-5/8 inch from both faces of the unit. Bond beam units which do not allow the two bars to be separated and to be within 2 5/8” of each face will not be acceptable.

C. Load-Bearing CMU: Provide units complying with ASTM C90, with a minimum compressive strength of as indicated in the Structural General Notes.

1. Normal Weight Units: ASTM C33 concrete aggregates for a dry net weight of not less than 125 pounds per cu. ft. Strength shall be as indicated above.
2. Curing: Cure units to comply with ASTM C90.

D. Concrete Building Brick: ASTM C55 and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength per structural notes.
2. Weight Classification: Normal weight.
3. Size: Manufactured to the actual dimensions listed below (within tolerances specified in the applicable referenced ASTM specification) for the corresponding nominal sizes indicated on the drawings.

    a. Modular: 3-5/8 inches thick by 2-1/4 inches high by 7-5/8 inches long.
    b. Exposed Faces: Manufacturer’s standard color and texture, unless otherwise indicated.

E. Integral water-repellent for concrete unit masonry: Factory fabricate all exterior- exposed concrete masonry units with Integral water repellent admixture in concrete mix.

1. Description: Integral liquid polymeric admixture mixed with concrete during production of concrete masonry units, which will cross link and become permanently locked into masonry unit to provide

resistance to water penetration (water permeance) to achieve a Class E rating when tested to ASTM E 514-74.

a. Flexural Bond Strength of Masonry: No statistically lower masonry flexural bond strength shall occur as a result of adding integral water- repellent CMU and mortar admixtures when compared to a control (containing no admixtures) CMU and mortar tested according to ASTM C 1357.
b. Compressive Strength of Masonry Prisms: No statistically lower compressive strength of prisms shall occur as a result of adding integral water-repellent CMU and mortar admixtures when compared to a control (containing no admixtures) CMU and mortar when tested according to ASTM C 1314.
c. Drying Shrinkage of CMU: No statistically higher drying shrinkage of the CMU shall occur as a result of adding integral water-repellent CMU admixture when compared to a control (containing no admixtures) CMU when tested according to ASTM C 426.

2. Acceptable products include the following:

a. ACM Chemistries, Inc., Norcross GA., product “RainBloc”.
b. BASF Corporation, Master Builders Solutions, Cleveland OH., product: “Rheopel Plus Mortar Admixture”.
c. GCP Applied Technologies, Cambridge MA., product: “Dry-Block Mortar Admixture”.

3. Fabricate blocks using water-repellent admixture at rate recommended by admixture manufacturer.

2.03 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.

1. Natural color.

B. Hydrated Lime: ASTM C 207, Type S.

C. Masonry Cement: ASTM C 91.

1. Products: Subject to compliance with requirements, provide masonry cement from one of the following manufacturers:

a. Capital Materials Corporation; Flamingo Color Masonry Cement.
b. Cemex S.A.B. de C.V
c. Essroc, Italcementi Group d. Holcim (US) Inc.
d. Lafarge North America Inc.;
e. Lehigh Cement Company;
f. National Cement Company, Inc.

D. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

2.04 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. Refer to mortar type indicted in Structural General Notes.

2.05 GROUT MIXES

A. Prepackaged grout (ready mix) complying with ASTM C 1107, or site-mixed Portland cement grout complying with ASTM C 476 may be used.

B. Grout for Unit Masonry: Comply with ASTM C476 for grout used in construction of reinforced unit masonry; provide grout of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout. Combine and thoroughly mix cementitious materials, aggregates and water mechanically for at least 5 minutes using the established mix design. Grout shall have a minimum compressive strength of 3,000 psi at 28 days.

1. Use fine grout in spaces less than 2 inches in least horizontal dimension; use coarse grout in spaces 2 inches or more in least horizontal dimension.
2. Measure and batch materials either by volume or weight such that the required proportions can be accurately controlled and maintained.
3. Mix grout with sufficient water to obtain a fluid pouring consistency without segregation of materials. A low or high range water reducer may be used.
4. Slump shall be between 8 and 11 inches at point of placement.
5. Grout which has hardened or stiffened due to hydration of the cement shall not be used, but in no case shall grout be used 1 hour after initial mixing water has been added to the dry ingredients.

2.06 REINFORCEMENT AND ANCHORAGE MATERIALS

A. Continuous Wire Reinforcing and Ties for Masonry; ASTM A951 and as follows:

1. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M
2. Exterior and Interior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side and Cross Rods: 0.148-inch diameter.
4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
5. Provide welded wire units prefabricated in straight lengths of not less than 10 foot, with matching corner ("L") and intersection ("T") units.
6. Fabricate from cold-drawn steel wire complying with ASTM A1064, with deformed or embossed continuous side rods and plain cross-rods, with unit width of 1-1/2 to 2 inches less than thickness of wall or partition.
7. Configurations:
    a. Single Wythe CMU:
        1) Ladder type, 1 side rod per face shell; between 5/8 inch and 1 inch mortar coverage at each face.
        2) Blok-Lok "BL10".
        3) Heckmann "1100 Series".
        4) H & B "#220 Ladder-Mesh"
    b. CMU backup for clay or shale brick veneer:
        1) Ladder type, 1 side rod per face shell; between 5/8 inch and 1 inch mortar coverage at each face.
        2) Adjustable veneer anchors, wire size W2.8 embedded into veneer at least 1-1/2 inches and extending not closer than 5/8 inch from the exposed face.
        3) Blok-Lok Blok-Lok "Adjustable Econo-Cavity Lok II BL42" with "Wedge-Lok" insulation retainers.
        4) Heckmann
        5) H & B Ladder Type #270".
8. Wire shall be galvanized and in accordance with the following:

a.	Joint reinforcement and anchors, interior walls	ASTM A641 (0.10 oz. per sq. ft.)
b.	Joint reinforcement, wire ties, or anchors in exterior walls	ASTM A153, Class B2 (1.50 oz. per sq. ft.)

c.	Sheet metal ties or anchors in exterior walls or a mean relative humidity exceeding 75 percent	ASTM A153, Class B2 (1.50 oz. per sq. ft.)

9. All ladder type joint reinforcing shall have cross rods spaced at 16 inches o.c.
10. For joint reinforcing in walls, other than those described above, refer to Drawings for particular requirements.

2.07 MISCELLANEOUS

A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.

B. Hot-Dip Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.

C. Steel Sheet, Galvanized after Fabrication: ASTM A 1008 cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153.

D. Steel Plates, Shapes, and Bars: ASTM A 36.

E. Anchoring Devices: Provide strap anchors, ties, inserts, bolts, and rods of type and size required.

1. Masonry to Masonry: Strap anchors 1/4-inch x 1-1/4 inches x 24 inches galvanized steel with bent ends.

   a. Standard: Dur-O-Wal or one of the following: “301Z” Heckman “272 Rigid Steel Anchor” Hohmann & Barnard, Inc. #344 Rigid Partition Anchor, or approved equal.

2. Masonry to Steel: AA Flex-O-Lok AA400, 3/16 inch diameter triangular wire ties and AA 401 1/4 inch diameter wire weld at anchors.
3. Finish: ASTM A153, 1.5 ounce hot-dip galvanized finish for exterior walls; standard mill finish for remaining areas.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication.

1. Provide units with either two loops or four loops as needed for number of bars indicated.
2. Reinforcing Bar Positioners:

   a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
   b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
   c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
   d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

G. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:

1. Headed bolts.
2. Nonheaded bolts, bent in manner indicated.

H. Postinstalled Anchors: Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing in accordance with ASTM E 488, conducted by a qualified independent testing agency.

1. Type: Expansion anchors.
2. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.

2.08 EMBEDDED FLASHING MATERIALS

A. Copper-Laminated Flashing: Manufacturer’s standard laminated flashing consisting of 5 oz./sq.ft. sheet copper bonded with asphalt between 2 layers of glass-fiber cloth.

1. Application: Use only where flashing is fully concealed in masonry.

a. Copper Fabric; AFCO Products, Inc.
b. Copper Fabric Flashing; Sandell Manufacturing Co., Inc.
c. York Copper Fabric Flashing; York Manufacturing, Inc.

B. Thru-Wall Flashing: Stainless steel; ASTM A167, Type 302/304, dead soft temper, 0.015 inch thick; dull matte finish.

C. Fabricate through-wall flashing with drip edge. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

2.09 WEEP/VENT MATERIALS

A. Weep Products: Use one of the following, unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

a. Products:

1) Advanced Building Products Inc.; Mortar Maze weep vent.
2) Blok-Lok Cell Vent
3) Heckmann Building Products Inc.; No. 85 Cell Vent.
4) Hohmann & Barnard, Inc.; #QV Quadro-Vent.
5) Wire-Bond; Cell Vent #3601.

B. Cavity Vent Products: Use the following, unless otherwise indicated:

1. Aluminum Weep Hole/Vent: One-piece, L-shaped units made from sheet aluminum, designed to fit into a head joint and consisting of a vertical channel with louvers stamped in web and with a top flap to keep mortar out of the head joint; painted before installation to comply with Division 9 painting Sections in color approved by Architect to match that of mortar.

a. Product: Hohmann & Barnard, Inc.; #343W
b. Wilko Weep Hole.

C. Mortar Deflection Devices:

1. Provide trapezoidal mortar net. 10" high polymer core geomatrix of nylon or high density polyethylene woven into a mesh; thickness as required for cavity wall.
2. Acceptable Products:

a. Advanced Building Products Inc.; Mortar Break II.
b. Archovations, Inc.; CavClear Masonry Mat.
c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
d. Mortar Net USA, Ltd.; Mortar Net.

2.10 MASONRY ACCESSORY MATERIALS

A. Preformed Control-Joint Gaskets: Styrene butadiene rubber compound conforming to ASTM D2000, Designation M2AA-805, regular design to fit standard sash block, with a durometer hardness of 80 when tested in accordance with ASTM D2240. Manufacturer:
Dur-O-Wal “Rapid Control Joint®” AA Wire Products “AA1000 Titewall,” or approved equal.

B. Compressible Filler: Premolded filler strips complying with ASTM D1056, Type 2, Class A, Grade 1; closed cell neoprene; compressible up to 35 percent; of width and thickness indicated. Manufacturer: Dur-O-Wal Rapid® Soft-Joint/Expansion Joint, AA3405 Joint-Tite of AA Wire Products, Hohmann & Barnard, Inc. #NS Closed Cell Neoprene Sponge, or approved equal.

C. Masonry Cleaners:

1. Job Mixed Detergent Solution: Solution of trisodium phosphate (1/2 cup dry measure) and laundry detergent (1/2 cup dry measure) dissolved in one gallon of water.
2. Proprietary Acidic Cleaner: Manufacturer's standard strength, general purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from masonry surfaces of type indicated below without discoloring or damaging masonry surfaces; expressly approved for intended use by manufacturer of masonry units being cleaned.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which masonry is to be installed and notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.

1. Examine surfaces which are to support masonry work to assume completion to proper lines and grades. Remove all dirt, laitance, loose aggregates, and other deleterious material.
2. Examine rough-in and built-in construction to verify actual locations prior to installation.

B. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to masonry installer.

C. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Consult other trades in advance and make provisions for installing their work in order to avoid cutting and patching. Provide openings for ducts, pipe, structural members, and other penetrations. Cut neatly around all ducts, pipes, etc., where required. Mortar solid the joints between cut openings and face of pipe sleeves, conduit runs and ductwork so that no opening exists through the masonry.

B. Clean reinforcement and shanks of anchor rods by removing mud, oil, or other materials that will adversely affect or reduce bond at the time mortar or grout is placed.

C. Reinforcement with rust, mill scale, or a combination of both are acceptable without cleaning or brushing provided the dimension and weights, including heights of deformations, or a cleaned sample are not less than required by the ASTM specification covering this reinforcement in this Section.

D. Protect base of exterior walls from splattering of mortar, soil, mud and other materials that might stain the masonry up to 4 feet above grade with a membrane similar to 45 mil EPDM or plywood sheathing material. Maintain protection for the entire duration of the project.

E. Protect all sills, ledges, and projections from droppings of mortar. Protect door jambs and corners from damage during masonry construction.

F. Prior to placing masonry, remove laitance, loose aggregate, and anything else that would prevent mortar from bonding to the foundation.

3.03 INSTALLATION – GENERAL

A. Thickness: Build masonry construction to the full thickness shown, except, build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness shown or specified.

B. Build chases and recesses as shown or required to accommodate items specified in this and other Sections of the Specifications. Provide not less than 8 inches of masonry between chase recess and jamb of openings and between adjacent chases and recesses.

C. Cut masonry units with motor-driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full-size units without cutting wherever possible.

D. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.

E. Establish lines, levels and coursing indicated. Protect from displacement.

F. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

G. Isolate masonry partitions from vertical structural framing and where indicated on the Drawings. Maintain joints free from mortar, ready to receive sealant and joint bead back-up.

H. Provide compressible filler at tops of interior masonry partitions abutting structural above.

3.04 PLACING AND BONDING

A. Build walls and other masonry construction to the full thickness shown. Note rustication coursing.

B. Lay masonry units in full bed of mortar, with full head and collar joints, uniformly jointed with other work. Use full size units without cutting whenever possible. Provide 100 percent solid units where webs or cores would be exposed.

C. Lay hollow masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in first course on footings and foundation walls, and adjacent to cells or cavities to be filled with grout. Fill collar joints between wythes solid with mortar in exterior walls of multiple wythe construction.

D. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.

E. Remove excess mortar as work progresses.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, after mortar has started to harden, remove mortar and replace with fresh mortar.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

H. Leave openings for equipment which is to be installed later in construction. After installation of equipment, complete masonry work to match work adjacent to the openings.

I. Cut neatly around pipes, conduit, and ducts. Fill cracks with mortar.

J. Isolate top joint of non-loadbearing masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler, and seal.

K. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise shown.

L. Rake out mortar in preparation for application of caulking or sealants where required.

3.05 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

B. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.

C. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.

D. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.

E. Locate anchor sections to allow maximum vertical differential movement of ties up and down.

F. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

3.06 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Lay-up walls plumb and true and with courses level, accurately spaced, within specified tolerances, and coordinated with other work. Do not wedge partitions tight against structural ceiling or beams, but provide a caulk or insulation filled joint between masonry and the structural roof deck, structural steel framing or structural floor deck at nonrated conditions. At rated walls, provide firestopping.

D. Lay concrete masonry units in running bond unless otherwise noted with vertical joint in each course centered on units in courses above and below. Provide coursing as indicated on drawings.

1. Form concave tooled mortar joints in all exposed work.
2. Compress and cut joints flush for masonry walls which are below grade, concealed, or covered by other materials.
3. Provide 3/8 inch joint widths, except for minor variations required to maintain bond alignment.

4. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4 inch horizontal face dimensions at corners or jambs.

E. Build non-load-bearing interior partitions full height of story to underside of solid floor structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
3. At fire-rated partitions, install firestopping in joint between top of partition and underside of structure above to comply with Section 07 84 00 – Firestopping.

F. Align unit cells or cores that are to be grouted.

G. Bond and interlock each course of each wythe at corners. Do not use units with less than 4 inches of horizontal face dimensions at corners or jambs.

1. Provide special coursing where indicated.
2. Provide uniform color blending in walls of exposed concrete masonry units to avoid patchy effect.
3. When joining fresh masonry to set or partially set masonry, remove loose unit and mortar, and clean and lightly, wet exposed surface of set masonry prior to laying fresh masonry.

H. Stopping and Resuming Work: Step back 1/2 masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry, and remove loose masonry units and mortar prior to laying fresh masonry.

3.07 BUILT-IN WORK

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. As work progresses, build in metal frames, anchor bolts, bearing plates, reinforcement, inserts, sleeves and other items furnished by other sections. Form chases and openings required for other work.

C. Provide solid masonry bearing for all lintels, beams, and load-bearing members. Provide solid masonry units or hollow units filled solid.

D. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod grout into core.

E. Build in items plumb and level.

F. Build in work of other trades without weakening or defacing masonry.

G. Obtain exact sizes of openings for ducts, grilles, louvers, piping, and other work furnished by other trades and properly build around same.

H. Locate pipe and conduit in walls accurately so as not to weaken the strength of the masonry.

I. Machine cut masonry neatly for installation of outlet boxes and similar equipment.

J. Provide anchoring devices of the type indicated and specified for anchoring masonry work. Provide open space not less than 1/2 inch width between masonry and structural member. Keep space free of mortar or other materials.

K. Install adjustable hollow metal frame anchors, locating anchors on jambs in horizontal bed courses near the top and bottom of each frame and at intermediate points not over 24 inches apart. Draw anchors tight and fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

1. Rake joints around exterior side of exterior hollow metal door frames for sealant.

2. Protect concealed faces of door frames in exterior masonry walls, using fibered asphalt emulsion coating. Apply over shop primer approximately 1/8 inch thick and allow to dry before handling.
3. Where hollow metal frames do not wrap around masonry jambs and heads, rub exposed corners of block to remove sharp, irregular edges.
4. Fill cores in hollow concrete masonry units with grout 3 courses (24 inches) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

L. Flashing / Weep System: Install continuously in block courses at base of wall, and above doors, windows and lintels in accordance with manufacturer's installation instructions.

1. Install core material in empty cells of first course above flashing.
2. Do not install core material in cells with reinforcing.

3.08 CAVITY WALLS

A. Lay wythes of cavity walls concurrently except where pintle and eye type horizontal joint reinforcing is shown. At no time shall a wythe be more than 16 inches higher than any other wythe being constructed concurrently.

B. Where pintle and eye joint reinforcement is shown, concrete masonry wythes may be laid up full height separate from facing wythe.

C. Keep cavity clean of mortar droppings by suspending by wires a wooden strip the width of the air space. Strip shall be lifted as each course of joint reinforcement is laid in facing wythe. Mortar shall be placed so that excess is not pressed into cavity air space as facing wythe is laid-up. Bevel mortar back from cavity face of brick to prevent mortar from being pressed into cavity as brick is tapped into position. Install cavity mortar protection in cavity above thru wall flashing and where indicated.

D. Tie exterior wythe to back-up with continuous horizontal joint reinforcing embedded in mortar joints at not more than 16 inches o.c. vertically.

E. Provide concealed flashing around entire perimeter at base of walls in first course above grade. Provide concealed flashing and cell vents above exterior wall openings and within exterior walls that project above adjacent lower roof(s); and at all locations shown on the Drawings and at any other locations as required to complete the integrity of system. Install as specified hereinafter. Flashing joints shall be made by lapping a minimum of 4 inches and coating the contacting surfaces with mastic.

F. Install insulation horizontally within cavity against inner wythe. Install between wall reinforcing, seal edges and fit tight around obstructions across the cavity. Use adhesive to secure insulation flush against inner wythe.

G. Fill all cracks and open gaps in insulation with sealant.

H. Provide cell vent in exterior wythe of cavity wall located immediately above ledges and flashing spaced 24 inches o.c., unless otherwise shown.

I. Provide sheet metal flashing drip for elastomeric flashing.

3.09 PLACING REINFORCEMENT

A. General: Comply with requirements of ACI 530.1/ASCE 6/TMS 602. Do not use reinforcement bars with kinks or bends not shown on final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.

B. Position reinforcement accurately at the spacing as indicated on the drawings. The minimum clear distance between bars and masonry units shall be 1/2 inch; and between parallel bars, the minimum clear distance shall be one bar diameter. Provide bars in vertical and horizontal directions as indicated. Reinforcement shall be held in place with centering clips or caging devices. Support and secure bars against displacement; secure vertical bars near each end and at intermediate intervals not exceeding 192 bar diameters. Set horizontal reinforcement in a full bed of mortar.

C. Splice reinforcement bars where shown; do not splice at other points unless acceptable to the Architect. Provide contact lapped splices, unless otherwise shown. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie. Lap ends not less than 40 bar diameters, unless otherwise indicated, or required by governing code.

D. Secure reinforcement to insure final position after grouting in accordance with the design requirements.

E. Bends, extensions, etc. shall comply with OBC requirements.

F. Tolerances:

1. Tolerances for the placement of steel in walls and flexural elements shall be ±1/2 inch when the distance from the centerline of steel to the opposite face of masonry, *d*, is equal to 8 inches or less, ±1 inch for *d* equal to 24 inches or less but greater than 8 inches, and ±1-1/4 inch for *d* greater than 24 inches.
2. Place vertical bars within 2 inches of the required location along the length of the wall.
3. If it is necessary to move bars more than one bar diameter or a distance exceeding the tolerance stated above to avoid interference with other reinforcing steel, conduits, or embedded items, notify the Architect for acceptance of the resulting arrangement of bars.

3.10 HORIZONTAL JOINT REINFORCEMENT

A. Provide continuous horizontal joint reinforcement in all unit masonry walls as follows:

1. Place reinforcing spaced at 16 inches on center vertically, full height of wall and every block course shown on the drawings, except at control/expansion joints.
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 24 inches each side of opening.
3. Place joint reinforcement continuous except at control joints.
4. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, pipe enclosures and other special conditions.
5. Lap joint reinforcement ends minimum 6 inches at splices, and provide preformed corners.

B. Install reinforcing steel and concrete grout specified in Section 03 30 00. Support and secure reinforcing bars from displacement. Comply with drawing details for steel size and spacing. Support and secure reinforcing bars from displacement. Maintain position of reinforcing within 1/2 inch of dimensioned position.

C. Embed anchors attached to structural steel members and grout solid.

3.11 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in- plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.

C. Control joint locations in concrete masonry, unless otherwise shown or detailed.

1. Maximum spacing: Lesser of 1-1/2 times overall wall height or 25 feet and as follows:

a. At changes in wall height.
b. At changes in wall thickness, such as at pipe chases and pilasters.
c. At (above) movement joints in foundations and floors.
d. At (below) movement joints in roofs and floors that bear on a wall.
e. On one side of openings less than six feet wide.
f. On both sides of openings more than six feet wide.
g. Adjacent to wall corners and intersections within distance equal to half control joint spacing.

3.12 GROUTING UNIT MASONRY

A. Grout filled or steel reinforced concrete block masonry foundations or masonry walls shall be reinforced and grouted as detailed on approved shop drawings.

B. Grout in the block cavities, completely fill each cavity with homogenous grout, extending from the lowest course to the top of the reinforced portion of the foundation or wall. Mortar shall not be used as grout for CMU.

C. Verify that locations of bond beams, pilasters, and other grouted components are as indicated on Drawings.

D. Reinforce bond beams as indicated. Comply with drawing details for steel size, quantity, and spacing.

E. Lap splices minimum 24 bar diameters. Caging devices and centering clips shall be spaced vertically such that every section of vertical reinforcing steel bar is restrained by 2 clips or devices, one near its top and one near its bottom. Maintain position within 1/2 inch of dimensioned position.

F. The low-lift grouting procedure shall be used as described in the Drawings and in NCMA- TEK 03-02A Grouting for Concrete Masonry Walls. Maximum height of grouting shall be 4 feet. Work grout into masonry cores and cavities to fill all voids.

G. At bearing locations, fill all masonry cores solid with coarse grout fill to dimensions indicated on the drawings.

3.13 LINTELS

A. Install loose steel lintels over window openings, door openings, and at other locations shown. Do not bond masonry work to bearing support ends of lintels.

3.14 REPAIRING, POINTING AND CLEANING

A. Remove and replace units which are loose, chipped, broken, stained, or otherwise damaged. Provide new masonry units to match adjoining units and install in fresh mortar pointed to eliminate evidence of replacement.

1. Provide new units to match adjoining units that cannot be successfully patched and install in fresh mortar, pointed to eliminates evidence of replacement

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weeps, and completely fill with mortar. Point-up all joints at corners, openings, and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on area as indicated by Architect and allow test area to dry 3 to 7 days. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry. Record methods.
3. Cover adjacent non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clean water.

    a. If chemical cleaners are to be sprayed on, the pressure shall not exceed 50 psi.

3.15 REPAIRING, POINTING AND CLEANING

A. Remove and replace units which are loose, chipped, broken, stained, or otherwise damaged. Provide new masonry units to match adjoining units and install in fresh mortar pointed to eliminate evidence of replacement.

B. Dry brush masonry surface after mortar has set at the end of each day's work and after final pointing. Remove excess mortar and mortar smears.

C. Periodically during construction, clean up and remove rubbish from premises.

D. Upon completion, go over all masonry work and remove and replace defective or open joints and holes with mortar.

E. Clean walls at a time which will permit a thorough cleaning without damage to any other finished surfaces. Clean soiled surfaces with cleaning solution.

F. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.16 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof. Test types as determined by the independent testing and inspection agency.

3.17 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove masonry waste and legally dispose of off the Site.

END OF SECTION

SECTION 051200

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.
3. Prefabricated building columns.
4. Shear stud connectors.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
3. Section 055000 "Metal Fabrications" for [**steel lintels and shelf angles not attached to structural-steel frame**] [**miscellaneous steel fabrications**] and other steel items not defined as structural steel.
4. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" Section 099600 "High-Performance Coatings" for painting requirements.

1.02 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.03 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

5. The following statements shall be placed on the front cover or initial sheet of each shop drawing submittal:

   a. Steel Fabricator Certification: The steel fabricator identified below certifies that for this project all load-bearing structural steel (as defined by the State of Ohio Department of Administrative Services, Directive Number GS-D-07, dated August 1, 2009) has been fabricated or produced, to the best of its knowledge, only from steel made in the United States in accordance with Sections 153.011 and 153.99, of the Ohio Revised Code (ORC). Further, the steel fabricator hereby certifies that it has read and understands that a monetary penalty for violations may be imposed under the authority of the referenced sections of the ORC. [Printed or Typed Name of Fabrication Company] by [Printed or typed Name of Company Official] Signature of Company Official
   _____ Date _____

D. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data[**signed and sealed by the qualified professional engineer responsible for their preparation**].

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer] [fabricator] [shop-painting applicators] [professional engineer] [testing agency].

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers
6. Nonshrink grout
7. Insert product.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control reports.

1.07 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Fabricator Qualifications: A qualified fabricator with not less than (10) years of successful experience in comparable installation projects and employing personnel skilled in the fabrication processes and operations indicated.

C. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, [**Category ACSE**] [**Category CSE**].

D. Installer Qualifications: A qualified installer with not less than (10) years of successful experience in comparable installation projects and employing personnel skilled in the installation processes and operations indicated.

E. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint [**Endorsement P1**] [**Endorsement P2**] [**Endorsement P3**] or to SSPC-QP 3.

F. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1. Welders and welding operators performing work on bottom-flange, demand-critical welds are to pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G are to be considered separate processes for welding personnel qualification.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 341.
3. ANSI/AISC 360.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.

    a. Select and complete connections using [**schematic details indicated**] [**and**] [**ANSI/AISC 360**] <**Insert source**>.
    b. Use [**Load and Resistance Factor Design; data are given at factored-load level**] [**Allowable Stress Design; data are given at service-load level**].

C. Moment Connections: [**Type PR, partially**] [**Type FR, fully**] restrained.

D. Construction: [**Moment frame**] [**Braced frame**] [**Shear wall system**] [**Combined system of moment frame and braced frame**] [**Combined system of moment frame and shear walls**] [**Combined system of braced frame and shear walls**] [**Combined system of moment frame, braced frame, and shear walls**].

E. DOMESTIC STEEL USE REQUIREMENTS AS SPECIFIED IN SECTION 153.011 OF THE REVISED CODE APPLY TO THIS PROJECT. COPIES OF SECTION 153.011 MAY BE OBTAINED FROM THE OFFICE OF THE OHIO FACILITIES CONSTRUCTION COMMISSION.

2.02 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [**25**] <**Insert value**> percent.

B. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so post-consumer recycled content plus one-falf of pre-consumer recycled content is not less than the following:

1. W-Shapes: 90 percent.
2. Channels, Angles, M, S-Shapes: 60 percent.
3. Plate and Bar: 30 percent.
4. Cold-Formed Hollow Structural Sections: 30 percent.
5. Steel Pipe: 30 percent.
6. All Other Steel Materials: 25 percent.

C. W-Shapes: ASTM A992/A992M ASTM A572/A572M, Grade 50 ASTM A529/A529M, Grade 50 ASTM A913/A913M, Grade 50.

D. Channels, Angles, M-Shapes: ASTM A36/A36M ASTM A572/A572M, Grade 50 ASTM A529/A529M, Grade 50 ASTM A913/A913M, Grade 50.

E. Channels, Angles, S-Shapes: ASTM A36/A36M ASTM A572/A572M, Grade 50 ASTM A529/A529M, Grade 50 ASTM A913/A913M, Grade 50.

F. Plate and Bar: ASTM A36/A36M ASTM A572/A572M, Grade 50 ASTM A529/A529M, Grade 50.

G. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C or ASTM A1085/ASTMA1085M structural tubing.

H. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

1. Weight Class: Standard Extra strong Double-extra strong.
2. Finish: Black Galvanized Black except where indicated to be galvanized.

I. Welding Electrodes: Comply with AWS requirements.

2.03 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating Mechanically deposited zinc coating Hot-dip or mechanically deposited zinc coating.

C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.04 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36 ASTM F1554, Grade 55, weldable ASTM A354 ASTM A449 ASTM A572/A572M, Grade 50 ASTM A36/A36M.

1. Configuration: Straight Hooked.
2. Nuts: ASTM A563 heavy-hex carbon steel.
3. Plate Washers: ASTM A36/A36M carbon steel.
4. Washers: ASTM F436, Type 1, hardened carbon steel.
5. Finish: Plain Hot-dip zinc coating, ASTM A153/A153M, Class C Mechanically deposited zinc coating, ASTM B695, Class 50.

B. Headed Anchor Rods: ASTM F1554, Grade 36 ASTM F1554, Grade 55, weldable ASTM A354 ASTM A449, straight.

1. Nuts: ASTM A563 heavy-hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain Hot-dip zinc coating, ASTM A153/A153M, Class C Mechanically deposited zinc coating, ASTM B695, Class 50.

C. Threaded Rods: ASTM A36/A36M ASTM A193/A193M, Grade B7 ASTM A354, Grade BD ASTM A449 ASTM A572/A572M, Grade 50.

1. Nuts: ASTM A63 heavy-hex carbon steel.

2. Washers: ASTM F436, Type 1, hardened ASTM A36/A36M carbon steel.
3. Finish: Plain Hot-dip zinc coating, ASTM A153/A153M, Class C Mechanically deposited zinc coating, ASTM B695, Class 50.

2.05 FORGED-STEEL STRUCTURAL HARDWARE

A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.

C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.06 SLIDE BEARINGS

A. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. Amscot Structural Products Corp.
    b. Fluorocarbon Company Limited.
    c. GRM Custom Products.
    d. R.J. Watson Bridge & Structural Engineered Systems.
    e. Insert manufacturer's name.

2. Mating Surfaces: PTFE and PTFE PTFE and mirror-finished stainless steel.
3. Coefficient of Friction: Not more than 0.03 0.04 0.05 0.06 0.10 0.12 Insert value.
4. Design Load: Not less than 2,000 psi 5,000 psi 6,000 psi Insert value.
5. Total Movement Capability: [2 inches] <**Insert dimension**>.

2.07 PRIMER

A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Galvanized-Steel Primer: MPI#26 MPI#80, MPI#134.

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 ASTM A780/A780M.

2.08 SHRINKAGE-RESISTANT GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.09 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, [**mechanically thermal cut,**]or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with [**SSPC-SP 1.**] [**SSPC-SP 2.**] [**SSPC-SP 3.**]

F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces.[**Do not thermally cut bolt holes or enlarge holes by burning.**]
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.10 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.11 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize [**lintels**] [**shelf angles**] [**and**] [**welded door frames**] attached to structural-steel frame and located in exterior walls.

2.12 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces [**unless indicated to be painted**].
6. Surfaces enclosed in interior construction.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 2.
2. SSPC-SP 3.
3. SSPC-SP 7 (WAB)/NACE WAB-4.
4. SSPC-SP 14 (WAB)/NACE WAB-8.
5. SSPC-SP 11.
6. SSPC-SP 6 (WAB)/NACE WAB-3.
7. SSPC-SP 10 (WAB)/NACE WAB-2.
8. SSPC-SP 5 (WAB)/NACE WAB-1.
9. SSPC-SP 8.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner [**or in accordance with SSPC-SP 16**].

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.13 SOURCE QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect[**and test**] shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E165/E165M.
    b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.

c. Ultrasonic Inspection: ASTM E164.
d. Radiographic Inspection: ASTM E94/E94M.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

   a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
   b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.

5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

   1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

   1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. [**Snug-tighten**] [**Pretension**] anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.[**Comply with manufacturer's written installation instructions for grouting.**]

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection[**unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M**].

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened Pretensioned Slip critical.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.05 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

2. Cleaning and touchup painting are specified in [**Section 099113 "Exterior Painting."**] [**Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]

C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.06 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. See Construction Drawings for Special Instruction requirements.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect[**and test**] bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

    a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

        1) Liquid Penetrant Inspection: ASTM E165/E165M.
        2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
        3) Ultrasonic Inspection: ASTM E164.
        4) Radiographic Inspection: ASTM E94/E94M.

3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION

SECTION 052100 -

STEEL JOIST FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. LH-series long-span steel joists.
5. DLH-series long-span steel joists.
6. Steel joist girders.
7. Steel joist accessories.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.

1.02 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.03 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [manufacturer] [professional engineer].

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

F. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications[**."**][**" and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."**]

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications[**."**][**" and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."**]

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.07 SEQUENCING

A. Deliver steel bearing plates to be built into [**cast-in-place concrete**] [**and**] [**masonry**] construction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. Canam Steel Corporation; Canam Group, Inc.
2. Gooder-Henrichsen Co.
3. New Millennium Building Systems, LLC.

4. Structures of U.S.A., Inc.
5. Valley Joist.
6. Vulcraft; Nucor Corporation, Verco Group.
7. .

2.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.

1. Use [**ASD; data are given at service-load level**] [**LRFD; data are given at factored-load level**].
2. Design special joists to withstand design loads with live-load deflections no greater than the following:

    a. Floor Joists: Vertical deflection of [**1/360**] [**1/240**] of the span.
    b. Roof Joists: Vertical deflection of [**1/360**] [**1/240**] of the span.

B. .

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.

2.03 STEEL JOISTS

A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists KCS-type K-series steel joists.
2. K-Series Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
3. Provide holes in chord members for connecting and securing other construction to joists.
4. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
5. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
6. Do not camber joists.
7. Camber joists according to SJI's "Specifications."
8. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on Drawings.

1. Joist Type: LH-series long-span steel joists and DLH-series long-span steel joists.
2. Provide holes in chord members for connecting and securing other construction to joists.
3. Camber long-span steel joists according to SJI's "Specifications." as indicated on Drawings. Insert camber requirements.
4. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.04 STEEL JOIST GIRDERS

A. Manufactured joist girders according to "Standard Specification for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated on Drawings.

1. Provide holes in chord members for connecting and securing other construction to joist girders.
2. Camber joist girders according to SJI's "Specifications." as indicated on Drawings. Insert camber requirements.
3. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.05 PRIMERS

A. Primer:

1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
2. Provide shop primer that complies with [Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."]

2.06 STEEL JOIST ACCESSORIES

A. Bridging:

1. Provide bridging anchors and number of rows of horizontal diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated on Drawings. Shop prime paint Hot-dip zinc coat according to ASTM A123/A123M.

C. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."

D. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.

1. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated on Drawings.
2. Finish: Plain, uncoated .

E. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

F. Other Bolts : ASTM A307. Refer to SJI Specifications for where each type of bolt is required.

1. Finish: Plain.

G. Welding Electrodes: Comply with AWS standards.

H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.07 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories[**to receive sprayed fire-resistive materials**].

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

D. Shop priming of joists and joist accessories is specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

PART 3 - |EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel [**bearing plates**] [**and**] [**framework**]. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 053100 -

STEEL DECKING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Roof deck.
2. Acoustical roof deck.
3. Composite floor deck.
4. Noncomposite form deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 035216 "Lightweight Insulating Concrete" for lightweight insulating concrete fill over steel deck.
3. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
4. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.02 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.
2. Acoustical roof deck.
3. Composite floor deck.
4. Noncomposite form deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.03 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

   a. Power-actuated mechanical fasteners.
   b. Acoustical roof deck.

2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.3/D1.3M.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [**25**] <**Insert value**> percent.

2.02 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
1. Canam Steel Corporation; Canam Group, Inc.
2. New Millennium Building Systems, LLC.
3. Nucor Corporation.
4. Nucor Corporation, Verco Group.
5. Vulcraft; Nucor Corporation, Verco Group.
6. Insert manufacturer's name.

B. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 50minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: Manufacturer's standard Gray White Gray top surface with white underside.

2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), , Grade 50 G60 G90 zinc coating.
3. Galvanized- and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), , Gade 50 G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: Manufacturer's standard Gray White Gray top surface with white underside.

4. Deck Profile: As indicated Type NR, narrow rib Type IR, intermediate rib Type WR, wide rib Type 3DR, deep rib Long span.
5. Profile Depth: As indicated 1-1/2 inches 2 inches 3 inches 4-1/2 inches 6 inches 7-1/2 inches.
6. Design Uncoated-Steel Thickness: As indicated 0.0295 inch 0.0358 inch 0.0474 inch 0.0598 inch 0.0747 inch.
7. Span Condition: As indicated Simple span Double span Triple span or more.
8. Side Laps: Overlapped Interlocking seam Overlapped or interlocking seam at Contractor's option.

2.03 ACOUSTICAL ROOF DECK

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. ASC Profiles, Inc.
2. Canam Steel Corporation; Canam Group, Inc.
3. Cordeck.
4. DACS, Inc.
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC.
7. Nucor Corporation.
8. Roof Deck, Inc.
9. Insert manufacturer's name.

B. Fabrication of Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 50 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: Manufacturer's standard Gray White Gray top surface with white underside.

2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 50, G60 zinc coating.
3. Galvanized- and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 50, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: Manufacturer's standard Gray White Gray top surface with white underside.

4. Aluminum-Zinc-Alloy-Coated Steel Sheet: ASTM A792/A792M, Structural Steel (SS), Grade 33 minimum, AZ50 aluminum-zinc-alloy coating.
5. Deck Profile: As indicated Type WR, wide rib Type 3DR, deep rib Long span.
6. Profile Depth: As indicated 1-1/2 inches 2 inches 3 inches 4-1/2 inches 6 inches 7-1/2 inches.
7. Design Uncoated-Steel Thickness: As indicated 0.0295 inch 0.0358 inch 0.0474 inch 0.0598 inch.
8. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated 0.0358/0.0358 inch 0.0358/0.0474 inch 0.0474/0.0358 inch 0.0474/0.0474 inch 0.0474/0.0598 inch 0.0598/0.0474 inch 0.0598/0.0598 inch.
9. Span Condition: As indicated Simple span Double span Triple span or more.

10. Side Laps: Overlapped Interlocking seam Overlapped or interlocking seam at Contractor's option.
11. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs Cellular deck units with manufacturer's standard perforated flat-bottom plate welded to ribbed deck.
12. Sound-Absorbing Insulation: Manufacturer's standard premolded roll or strip of glass or mineral fiber. <**Insert actual physical properties and thicknesses of insulation**>.

    a. Factory install sound-absorbing insulation into cells of cellular deck.
    b. Installation of sound-absorbing insulation is specified in <**Insert Section number and title**>.

13. Acoustical Performance: NRC 0.65 0.75 0.80 0.85 0.90, tested in accordance with ASTM C423.

2.04 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. ASC Profiles, Inc.
2. Canam Steel Corporation; Canam Group, Inc.
3. Cordeck.
4. DACS, Inc.
5. Epic Metals Corporation.
6. Marlyn Steel Decks, Inc.
7. New Millennium Building Systems, LLC.
8. Nucor Corporation.
9. Nucor Corporation, Verco Group.
10. Roof Deck, Inc.
11. Vulcraft; Nucor Corporation, Verco Group.
12. Insert manufacturer's name.

B. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 40 , G60 zinc coating.
2. Galvanized- and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 40, G60 zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard [gray] [white] baked-on, rust-inhibitive primer.
3. Profile Depth: 1-1/2 inches 2 inches 3 inches As indicated.
4. Design Uncoated-Steel Thickness: 0.0295 inch 0.0358 inch 0.0474 inch 0.0598 inch.
5. Span Condition: As indicated Simple span Double span Triple span or more.

2.05 NONCOMPOSITE FORM DECK

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. ASC Profiles, Inc.
2. Canam Steel Corporation; Canam Group, Inc.
3. Cordeck.
4. DACS, Inc.
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC.
7. Nucor Corporation.
8. Nucor Corporation, Verco Group.
9. Roof Deck, Inc.
10. Valley Joist.

11. Vulcraft; Nucor Corporation, Verco Group.
12. Insert manufacturer's name.

B. Fabrication of Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite deck panels used as a form to comply with SDI NC, with the minimum section properties indicated, and with the following:

1. Uncoated Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 Grade 40 Grade 80 minimum.
2. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 Grade 40 Grade 80 minimum, with top and underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: Manufacturer's standard Gray White Gray top surface with white underside.

3. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 Grade 40 Grade 80, G30 G60 G90 zinc coating.
4. Galvanized- and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), [Grade 33] [Grade 80], G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: [Manufacturer's standard] [Gray] [White] [Gray top surface with white underside].

5. Profile Depth: 9/16 inch 15/16 inch 1-5/16 inches 1-1/2 inches.
6. Design Uncoated-Steel Thickness: 0.0149 inch 0.0179 inch 0.0239 inch 0.0295 inch 0.0358 inch 0.0474 inch 0.0598 inch.
7. Span Condition: As indicated Simple span Double span Triple span or more.
8. Side Laps: Overlapped Interlocking seam Overlapped or interlocking seam at Contractor's option.
9. ASC Profiles, Inc.
10. Canam Steel Corporation; Canam Group, Inc.
11. Marlyn Steel Decks, Inc.

2.06 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated recommended by SDI standards for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and [level] [sloped] recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

L. Galvanizing Repair Paint: ASTM A780/A780M SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

3.03 INSTALLATION OF ROOF DECK

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: [5/8 inch] [3/4 inch], nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds [18 inches **apart, maximum**] [12 inches **apart in Zone 1 and** 6 inches **apart in Zones 2 and 3, based on roof-area definitions in FM Global Loss Prevention Data Sheet 1-28**] [**as indicated**].
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or [18 inches] [36 inches], and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: [**Lapped** 2 inches **minimum**] [**Butted**] [**Lapped** 2 inches **minimum or butted at Contractor's option**].

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and [**weld**] [**mechanically fasten**] flanges to top of deck. Space [**welds**] [**mechanical fasteners**] not more than 12 inches apart with at least one [**weld**] [**fastener**] at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and [**weld**] [**or**] [**mechanically fasten**].

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. [**Weld**] [**or**] [**mechanically fasten**] to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive in accordance with manufacturer's written instructions to ensure complete closure.

G. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified in <**Insert Section number and title**>.

3.04 INSTALLATION OF FLOOR DECK

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: [5/8 inch] [3/4 inch], nominal.
2. Weld Spacing:

   a. Weld edge ribs of panels at each support. Space additional welds an average of 16 inches apart, but not more than 18 inches apart.
   b. Space and locate welds as indicated.

3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of [1-1/2 inches] <**Insert dimension**>, with end joints as follows:

1. End Joints: [**Lapped**] [**Butted**] [**Lapped or butted at Contractor's option**].

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

F. Install piercing hanger tabs at [14 inches] <**Insert dimension**> apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides unless otherwise indicated.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.

a. Field welds will be subject to inspection.

2. Steel decking will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 054000

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Interior non-load-bearing wall framing.
4. Floor joist framing.
5. Roof rafter framing.
6. Ceiling joist framing.
7. Soffit framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
3. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.02 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

1. <**Insert participants**>.

1.03 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Interior non-load-bearing wall framing.
5. Vertical deflection clips.
6. Single deflection track.
7. Double deflection track.
8. Drift clips.
9. Floor joist framing.
10. Roof-rafter framing.
11. Ceiling joist framing.
12. Soffit framing.
13. Post-installed anchors.
14. Power-actuated anchors.
15. Sill sealer gasket.
16. Sill sealer gasket/termite barrier.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

D. Delegated Design Submittal: For cold-formed steel framing.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Product Test Reports: For each listed product, for tests performed by [**manufacturer and witnessed by a qualified testing agency**] [**a qualified testing agency**].

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

E. Research Reports:

1. For nonstandard cold-formed steel framing [**post-installed anchors**] [**and**] [**power-actuated fasteners**], from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
2. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency[**, or in-house testing with calibrated test equipment,**] indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of [**the Certified Steel Stud Association**] [**the Steel Framing Industry Association**] [**the Steel Stud Manufacturers Association**] [**or**] [**the Supreme Steel Framing System Association**].

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

E. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. AllSteel & Gypsum Products, Inc.
2. CEMCO; California Expanded Metal Products Co.
3. ClarkDietrich.
4. Consolidated Fabricators Corp.; Building Products Division.
5. Craco Manufacturing, Inc.
6. Custom Stud.
7. Design Shapes in Steel.
8. Formetal Co. Inc. (The).
9. Jaimes Industries.
10. MarinoWARE.
11. MBA Building Supplies.
12. MRI Steel Framing, LLC.
13. Olmar Supply, Inc.
14. Quail Run Building Materials, Inc.
15. SCAFCO Steel Stud Company.
16. Southeastern Stud & Components, Inc.
17. State Building Products, Inc.
18. Steel Construction Systems.
19. Steel Structural Systems.
20. Steeler, Inc.
21. Super Stud Building Products Inc.
22. Telling Industries.
23. The Steel Network, Inc.
24. United Metal Products, Inc.
25. United Steel Deck, Inc.
26. Insert manufacturer's name.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: [**As indicated on Drawings**] <**Insert design loads**>.
2. Deflection Limits: Design framing systems to withstand[**design loads**] without deflections greater than the following:

    a. Exterior Load-Bearing Wall Framing: Horizontal deflection of [**1/240**] [**1/360**] [**1/600**] [**1/720**] of the wall height.
    b. Interior Load-Bearing Wall Framing: Horizontal deflection of [**1/240**] [**1/360**] of the wall height under a horizontal load of 5 lbf/sq. ft..
    c. Exterior Non-Load-Bearing Framing: Horizontal deflection of [**1/240**] [**1/360**] [**1/600**] [**1/720**] <**Insert ratio**> of the wall height.
    d. Interior Non-Load-Bearing Framing: Horizontal deflection of [**1/240**] [**1/360**] of the wall height under a horizontal load of 5 lbf/sq. ft..
    e. Floor Joist Framing: Vertical deflection of [**1/360**] [**1/480**] for live loads and l/240 for total loads of the span.
    f. Roof Rafter Framing: Vertical deflection of [**1/120**] [**1/240**] [**1/360**] of the horizontally projected span for live loads.
    g. Ceiling Joist Framing: Vertical deflection of [**1/120**] [**1/240**] [**1/360**] of the span for live loads and 1/240 for total loads of the span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

    a. Upward and downward movement of [1/2 inch] [3/4 inch] [1 inch] [1-1/2 inches].

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and [**ASTM C955**] [**AISI S200 and ASTM C955, Section 8**] [**AISI S240**].

D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.03 COLD-FORMED STEEL FRAMING MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [**25**] <**Insert value**> percent.

B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST33H ST50H As required by structural performance Insert grade.
2. Coating: G60, A60, AZ50, or GF30 G90 or equivalent Insert coating designation.

C. Steel Sheet for Vertical Deflection Drift Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 33 50, Class 1 As required by structural performance Insert grade.
2. Coating: G60 G90 Insert coating designation.

2.04 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
2. Flange Width: 1-3/8 inches 1-5/8 inches 2 inches 2-1/2 inches Insert dimension.
3. Section Properties: <**Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment**>.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Matching steel studs Insert dimension.
2. Flange Width: [1-1/4 inches] <**Insert dimension if manufacturer's standard width is insufficient**>.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
2. Flange Width: 1-3/8 inches 1-5/8 inches 2 inches 2-1/2 inches Insert dimension.
3. Section Properties: <**Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment**>.

D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
2. Top Flange Width: 1-1/2 inches 1-5/8 inches 2 inches 2-1/2 inches Insert dimension.
3. Section Properties: <**Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment**>.

2.05 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
2. Flange Width: 1-3/8 inches 1-5/8 inches 2 inches 2-1/2 inches Insert dimension.
3. Section Properties: <**Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment**>.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: [0.0329 inch] [0.0428 inch] [0.0538 inch] [0.0677 inch] [0.0966 inch] [Matching steel studs] <Insert dimension>.

2. Flange Width: [1-1/4 inches] <**Insert dimension if manufacturer's standard width is insufficient**>.

C. Vertical Deflection Clips, Exterior: Manufacturer's standard [bypass] [head] clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. AllSteel & Gypsum Products, Inc.
b. ClarkDietrich.
c. MarinoWARE.
d. SCAFCO Steel Stud Company.
e. Simpson Strong-Tie Co., Inc.
f. Steel Construction Systems.
g. Steeler, Inc.
h. The Steel Network, Inc.
i. <Insert manufacturer's name>.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: [0.0428 inch] [0.0538 inch] [0.0677 inch] [0.0966 inch] <Insert dimension>.
2. Flange Width: [1 inch plus the design gap for one-story structures] [and] [1 inch plus twice the design gap for other applications] <Insert dimension>.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

a. Minimum Base-Metal Thickness: [0.0329 inch] [0.0428 inch] [0.0538 inch] [0.0677 inch] [0.0966 inch] <Insert dimension>.
b. Flange Width: [1 inch plus the design gap for one-story structures] [and] [1 inch plus twice the design gap for other applications] <Insert dimension>.

2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: [0.0428 inch] [0.0538 inch] [0.0677 inch] [0.0966 inch] <Insert dimension>.
b. Flange Width: <**Insert dimension equal to sum of outer deflection track flange width plus** 1 inch>.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.06 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
2. Flange Width: 1-3/8 inches 1-5/8 inches 2 inches 2-1/2 inches Insert dimension.
3. Section Properties: <**Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment**>.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Matching steel studs Insert dimension.
2. Flange Width: [1-1/4 inches] <**Insert dimension if manufacturer's standard width is insufficient**>.

C. Vertical Deflection Clips, Interior: Manufacturer's standard bypass head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. AllSteel & Gypsum Products, Inc.
b. ClarkDietrich.
c. MarinoWARE.
d. SCAFCO Steel Stud Company.
e. Simpson Strong-Tie Co., Inc.
f. Steeler, Inc.
g. The Steel Network, Inc.
h. Insert manufacturer's name.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
2. Flange Width: 1 inch plus the design gap for one-story structures 1 inch plus twice the design gap for other applications Insert dimension.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

a. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
b. Flange Width: 1 inch plus the design gap for one-story structures 1 inch plus twice the design gap for other applications Insert dimension.

2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
b. Flange Width: <**Insert dimension equal to sum of outer deflection track flange width plus** 1 inch>.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.07 FLOOR JOIST FRAMING

A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, unpunched, punched with standard holes, punched with enlarged service holes, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
2. Flange Width: 1-5/8 inches 2 inches 2-1/2 inches Insert dimension, minimum.
3. Section Properties: <**Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment**>.

B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Matching steel joists Insert dimension.
2. Flange Width: 1-1/4 inches 1-1/2 inches 2 inches Insert dimension, minimum.

2.08 ROOF-RAFTER FRAMING

A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
2. Flange Width: 1-5/8 inches 2 inches 2-1/2 inches Insert dimension, minimum.
3. Section Properties: <**Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment**>.

2.09 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, punched with standard holes, punched with enlarged service holes, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
2. Flange Width: 1-5/8 inches 2 inches 2-1/2 inches Insert dimension, minimum.
3. Section Properties: <**Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment**>.

2.10 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch 0.0428 inch 0.0538 inch 0.0677 inch 0.0966 inch Insert dimension.
2. Flange Width: 1-5/8 inches 2 inches 2-1/2 inches Insert dimension, minimum.

3. Section Properties: <**Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment**>.

2.11 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole-reinforcing plates.
11. Backer plates.

2.12 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36 Grade 55, threaded carbon-steel hex-headed bolts, headless, hooked bolts, headless bolts, with encased end threaded, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C mechanically deposition according to ASTM B695, Class 50.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC193 ICC-ES AC58 ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: Torque-controlled expansion anchor Torque-controlled adhesive anchor adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 Group 2 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.13 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M MIL-P-21035B SSPC-Paint 20.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.14 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

E. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.04 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: [24 inches] [32 inches] [**To match stud spacing**] [**As shown on Shop Drawings**] <**Insert dimension**>.

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.

1. Fasten both flanges of studs to top and bottom tracks.
2. Space studs as follows:

a. Stud Spacing: [12 inches] [16 inches] [19.2 inches] [24 inches] [**As indicated on Drawings**] <**Insert dimension**>.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically [48 inches] [**as indicated on Drawings**] [**as indicated on Shop Drawings**] <**Insert dimension**>. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.05 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to[**top and**] bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: [12 inches] [16 inches] [19.2 inches] [24 inches] [**As indicated on Drawings**] <**Insert dimension**>.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to [**bypassing**] [**infill**] studs and anchor to building structure.
4. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated[**on Shop Drawings**] but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within [12 inches] [18 inches] of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at [96-inch **centers**] [**centers indicated**] [**centers indicated on Shop Drawings**].

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.06 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to[**top and**] bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: [12 inches] [16 inches] [19.2 inches] [24 inches] [**As indicated on Drawings**] <**Insert dimension**>.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to studs and anchor to building structure.
4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated[**on Shop Drawings**] but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within [12 inches] [18 inches] of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at [96-inch **centers**] [**centers indicated**] [**centers indicated on Shop Drawings**].

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.07 INSTALLATION OF JOIST FRAMING

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated[**on Shop Drawings**].

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.

C. Space joists not more than 2 inches from abutting walls, and as follows:

1. Joist Spacing: [12 inches] [16 inches] [19.2 inches] [24 inches] [**As indicated on Drawings**] <**Insert dimension**>.

D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated[**on Shop Drawings**]. Fasten bridging at each joist intersection as follows:

1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.08 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.09 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes materials and services to fabricate and install miscellaneous metals indicated or required to complete the work and not specified in other Sections.

B. This Section includes, but is not limited to, the following:

1. Loose steel lintels (Interior)
2. Steel framing and supports for mechanical and electrical equipment and applications where framing and supports are not specified in other Sections.
3. Miscellaneous metal trim.

C. Related Sections:

1. Section 03 30 00 – Cast-In-Place Concrete for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items indicated to be cast into concrete
2. Section 04 22 00 – Concrete Unit Masonry for installing anchor bolts and other items indicated to be built into concrete unit masonry.
3. Section 05 12 00 – Structural Steel for structural-steel framing system components.
4. Section 05 51 23 – Alternating Tread Stairs
5. Section 09 91 00 – Painting: Field-applied painted finish.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. Delegated Design: Design metal fabrications, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Professional engineer shall be legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.03 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For the following:

1. Paint products
2. Grout

C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for countertops.
2. Steel framing and supports for mechanical and electrical equipment.

3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Metal ladders.

1.04 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."
3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.07 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

C. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

PART 2 – PRODUCTS

2.01 GENERAL

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.02 FERROUS METALS

A. Steel Plates, Shapes, and Bars; ASTM A36.

B. Steel Tubing: Cold-formed steel tubing complying with ASTM A500.

C. Steel Pipe: ASTM A53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads or drawings.

D. Malleable-Iron Castings: ASTM A47, Grade 32510 (ASTM A47M, Grade 22010).

E. Gray-Iron Castings: ASTM A48, Class 30 (ASTM A48M, Class 200), unless another weight is indicated or required by structural loads or drawings.

F. Cast-In-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a minimum safety factor of 4, as determined by testing per ASTM E488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A47 malleable iron or ASTM A27 cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A153/A.

G. Welding Rods and Bare Electrodes: Select according to AW S specifications for metal alloy welded.

2.03 METAL COATINGS

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified- alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

B. Galvanizing: Zinc coating in accordance with ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

1. Structural shapes and plates: 1/4 inch thickness: Grade 85; 1/4 inch thickness: Grade 100.

C. Galvanizing Repair Paint: High-zinc-dust-content for re-galvanizing welds in steel, complying with SSPC-Paint 20.

D. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D1187.

2.04 FASTENERS

A. All fasteners in exterior assemblies or exterior walls to be stainless steel.

B. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

C. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring iron fabrications to other types of construction indicated and capable of withstanding design loads.

D. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

E. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.

F. Anchor Bolts: ASTM F 1554, Grade 36. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

G. Plain Washers: Round, carbon steel, ASME B18.22.1.

H. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.

I. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

J. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material for Anchors in Exterior Locations: Alloy Group 2 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.05 MISCELLANEOUS ITEMS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 09 painting Sections.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

D. Intermediate Coats and Topcoats: Provide products that comply with Division 09 painting sections.

E. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 – Cast-in-Place Concrete for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

H. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.06 FABRICATION

A. Shop fabricate items complete and ready for installation. Fabricate metal items of material, size, and thickness indicated as required to produce the strength and durability in the finished assembly for the use intended. Work to the dimensions shown on approved shop drawings. Use type of materials shown or specified for various components of the work. Meet structural requirements considered structural in nature.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Drill or punch all holes required for attachment of work of other trades and for bolted connections. Burned holes are not acceptable.

D. Form work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

E. Weld shop connections, except as otherwise indicated. Weld corners and seams continuously, complying with AWS recommendations. Grind exposed welds smooth and flush, to minimize joint width and to match and blend with adjoining surfaces, so that no roughness shows after finishing and joints and welds are not visible.

F. Use concealed fasteners wherever possible. Provide phillips flathead (countersunk) screws or bolts for exposed fasteners unless otherwise indicated or specified.

G. Prepare metal work for anchorage of the type indicated, coordinated with the supporting structure. Fabricate and space anchoring devices as indicated or as required to provide adequate support of the intended use of the work.

H. Fabricate joint which will be exposed to the weather in a manner to exclude water.

I. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

J. Remove sharp or rough areas on exposed traffic surfaces.

K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.07 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning".
2. Interiors (SSPC Zone 1A): SSPC-SP3, "Power Tool Cleaning".

C. All ferrous metals in exterior assemblies or exterior walls to be hot dipped galvanized after fabrication.

D. Galvanizing: Hot-dip galvanize items exposed to weather, high moisture, corrosive conditions, and as indicated to comply with applicable standard listed below:

1. ASTM A 123, two ounces per square foot, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

E. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1", for shop painting.

1. Immediately after surface preparation, brush or spray on primer in accordance with manufacturer's instructions, and at a rate to provide uniform dry film thickness of 2.0 mils for each coat. Use painting methods which will result in full coverage of joints, corners, edges, and exposed surfaces.
2. Apply one shop coat to fabricated metal items, except apply two coats of paint to surfaces inaccessible after assembly or erection and on all lintels and other members built into exterior masonry walls. Change color of second coat to distinguish it from the first.
3. Metal fabrications that are indicated to be field painted shall be primed painted again with the coating systems specified in Section 09 91 00, and finished painted with specified coating system.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, supporting structure and installation conditions. Do not proceed with metal fabrication installation until unsatisfactory conditions have been corrected.

B. Installation constitutes acceptance of existing conditions and responsibility of satisfactory performance.

3.02 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates and instructions for installation of anchorages which are required to be cast into concrete or embedded in masonry construction.

3.03 INSTALLATION

A. Provide anchorage devices and fasteners necessary for securing metal fabrications to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

1. Conceal fasteners whenever possible.
2. Secure metal to wood with lag screws of adequate size, with appropriate washers.
3. Secure metal to concrete with embedded anchors, sleeves, setting components or setting grout.
4. Use expansion bolts, toggle bolts or screws for light duty service only.
5. Provide all fabricated items complete with attachment devices required for installation.

B. Perform cutting, drilling and fitting required for installation of metal fabrications. Set work accurately in location, alignment and elevation, plumb, level true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.

C. Fit exposed connections accurately together to form hairline joints. Weld connections which are not to be left as exposed joints. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dipped galvanized after fabrication and are intended for bolted or screwed field connections.

D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made and methods used in correcting welding work.

3.04 SCHEDULE

A. Provide and install items listed in Schedule and shown on Drawings with anchorage and attachments necessary for installation.

B. Loose Steel Lintels:

1. General Contractor shall furnish lintels for all openings through walls when openings are shown on the architectural or structural (General Contract) drawings. Note all such lintels and openings to require coordination of work and exact locations, by affected contractors. All such plumbing, HVAC, electrical, and sprinkler openings must be coordinated and shown on the Architectural and/or Structural Drawings.
2. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in walls and partitions at locations indicated.
3. Lintels sized as scheduled in “Structural Notes” on structural drawings.

C. Miscellaneous Framing and Supports:

1. Provide miscellaneous steel framing and supports which are not a part of structural steel framework, as required to complete the work.
2. Fabricate miscellaneous units to sizes, shapes and profiles shown or, if not shown, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
3. Provide interior miscellaneous framing and supports shop primed, exterior items galvanized. Painting as scheduled in Section 09 91 00 – Painting.
4. Miscellaneous items cast-in concrete; galvanized finish.

END OF SECTION

SECTION 05 51 34

ALTERNATING TREAD STAIRS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Steel alternating tread stair.
2. Handrails.

1.02 DESIGN REQUIREMENTS

A. Fabricate stair assembly to support a concentrated load of 1000 lb/sq ft without deformation.

B. Design handrail, and attachments to resist forces as required by ASCE 7 and IBC code. Apply loads non-simultaneously to produce maximum stresses.

1. Top Rail Concentrated Load: 200 pounds applied at any point in any direction.

1.03 ACTION SUBMITTALS

A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

C. Design Data: Submit design calculations signed and sealed by professional engineer.

1.04 QUALIFICATIONS

A. Prepare Shop Drawings under direct supervision of a professional engineer experienced in design of this work and licensed in the Commonwealth of Pennsylvania.

B. Welders' Certificates: AWS qualified within the previous 12 months.

1.05 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 – PRODUCTS

2.01 METAL STAIRS

A. Manufacturers:

1. Lapeyre Stair, Inc.
2. Substitutions: Section 01 25 00 – Substitution Procedures.

B. Stair: Alternating tread type; inclination angle as indicated on Drawings.

2.02 MATERIALS

A. Sheet Steel: ASTM A569.

B. Steel Tubing: ASTM A513, fully annealed.

C. Welding Materials: AWS D1.1; type required for materials being welded.

2.03 COMPONENTS

A. Treads: 13 gage sheet steel.

B. Landings and Foot Stampings: 11 gage sheet steel.

C. Stringers: 11 gage sheet steel formed to tubular shape, size required for stair angle.

D. Handrails: 1-1/2 inch OD x 0.083 inch wall thickness steel tubing.

2.04 FABRICATION

A. Fit and shop assemble components in largest practical sections, for delivery to site.

B. Fabricate components with joints tightly fitted and secured; welded construction. Fabricate handrails for bolted connection to stair.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

E. Accurately form components required for anchorage of stairs and railings to each other and to building structure.

2.05 SHOP FINISHING

A. Shop paint with manufacturer's standard powder coat finish. Color. _____

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.02 PREPARATION

A. Supply items required to be cast into concrete or embedded in masonry with setting templates.

3.03 INSTALLATION

A. Install stair in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects.

C. Provide anchors required for connecting stairs to structure.

D. Mechanically fasten joints butted tight, flush, and hairline.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes rough carpentry work including the following:

1. Concealed blocking for use in architectural woodwork restoration and for support of accessories, countertops, equipment, fixtures, specialty items, trim and facing materials.
2. Plywood sheathing and backer boards.
3. Rough hardware and accessory materials.

1.02 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. APA – The Engineered Wood Association:
    a. APA Design/Construction Guide: "Residential and Commercial," Form No. E30V (2011).
    b. APA PRP-108 – “Performance Standards and Policies for Structural-Use Panels.”
2. AWPA – American Wood Protection Association:
    a. AWPA M4 – “Standard for the Care of Preservative Treated Wood Products.”
    b. AWPA U1-16 – Use Category System: User Specification for Treated Wood.
3. NELMA: Northeastern Lumber Manufacturers Association
    a. Standard Grading Rules for Northeastern Lumber.
4. NLGA – National Lumber Grades Authority.
5. SPIB – Southern Pine Inspection Bureau.
    a. Standard Grading Rules for Southern Pine Lumber.
6. U.S. Department of Commerce, National Institute of Standards and Technology; Product Standards (PS): Softwood Lumber and Plywood Standards:
    a. DOC PS1 – "Construction and Industrial Plywood."
    b. DOC PS2 – "Performance Standard for Wood-based Structural Use Panels."
    c. DOC PS20 – "American Softwood Lumber Standard."
7. WWPA – Western Wood Products Association.
    a. Western Lumber Grading Rules.

1.03 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures for submittal requirements.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

C. Material certificates for dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee's (ALSC) Board of Review.

1.04 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Lumber shall conform to U.S. Product Standard PS20, "American Lumber Standards for Softwood Lumber."

1. Lumber grades shall conform to grading rules of association under which lumber is produced and shall bear official grade and trademark of the inspection bureau of the association.

C. Construction Panel Standards: PS 1, U.S. Product Standard for Construction and Industrial Plywood; APA PRP-108.

D. Preservative Treatment: AWPA Standard U1; waterborne pressure treatment. Provide for wood in contact with soil, concrete, masonry, roofing, flashing, dampproofing and waterproofing or where indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber and plywood well off the ground to ensure proper ventilation and drainage. Cover top and sides and protect from the elements, dampness, high humidity, damage and breakage. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

B. Store, handle, and protect treated lumber and plywood materials in accordance with AWPA M4 "Care of Pressure-Treated Wood Products."

1.06 COORDINATION

A. Fit rough carpentry to other work. Scribe and cope for accurate fit. Coordinate location of furring, nailers, blocking, grounds, and similar supports to allow proper attachment of other work.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Lumber Standards: Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

B. Inspection Agencies: Inspection agencies and abbreviations used to reference them with lumber grades and species include the following:

1. SPIB – Southern Pine Inspection Bureau.
2. WCLIB – West Coast Lumber Inspection Bureau.
3. WWPA – Western Wood Products Association.

C. Grade Stamps: Provide lumber with each piece factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

D. Quality Mark: Treated wood members shall bear an end tag or permanent ink stamp indicating the following:

1. Identification of treating manufacturer.
2. Type of preservative used.
3. Minimum preservative retention (pcf).
4. End use for which the product is treated.
5. AWPA standard to which the product was treated.
6. Identity of the accredited inspection agency

E. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

1. Provide dressed lumber, S4S, unless otherwise indicated.

2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

2.02 WOOD-PRESERVATIVE TREATED MATERIALS

A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA Standard U1 Use Category UC2. Commodity Specification A, to the requirements of Use Category 2 (UC2) Mark each treated item with the Quality Mark Requirements of and inspection agency approved by ALSC's Board of Review.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium:

a. Preservative chemical products containing chromium, arsenic, creosote, pentachlorophenol, copper naphthenate or copper 8-quinolinolate are prohibited.

B. Pressure treat wood members with waterborne preservatives as follows:

1. Aboveground items: Minimum retention rate of 0.25 lb./cu. ft.

C. Moisture content. Where preservative-treated wood is used in enclosed locations where drying in service cannot readily occur, such wood shall be at a moisture content of 19 percent or less before being covered with other materials.

D. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material. Inspect each piece of lumber and plywood after drying and discard damaged or defective pieces.

E. Application: Treat items as follow:

1. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

2.03 MISCELLANEOUS LUMBER

A. General: Provide lumber of grade indicated according to ALSC National Grading Rule (NGR) provisions, for support or attachment of the construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

1. Grade: No. 2.
2. Species:

a. Spruce-pine-fir south; NELMA.
b. Southern pine; SPIB.
c. Douglas-fir-larch: WCLIB or WWPA.
d. Hem-fir: WCLIB or WWPA.

3. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shaped shown.
4. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

2.04 WOOD-BASED STRUCTURAL-USE PANELS, GENERAL

A. Provide either all-veneer, mat-formed, or composite panels complying with DOC PS2, "Performance Standard for Wood-Based Structural-Use Panels," unless otherwise indicated. Provide plywood panels complying with DOC PS 1, "U.S. Product Standard for Construction and Industrial Plywood," where plywood is indicated.

B. Factory mark structural use panels with APA trademark evidencing compliance with grade requirements.

2.05 CONCEALED, PERFORMANCE-RATED STRUCTURAL-USE PANELS

A. Where structural-use panels are indicated for the following concealed types of applications, provide APA-performance rated panels complying with requirements designated under each application for grade, span rating, exposure durability classification, and edge detail.

1. Thickness Provide panels meeting requirements specified but not less than the thickness indicated.
2. Span Ratings: Provide panels with span ratings required to meet “Code Plus” provisions of APA Design/Construction Guide: "Residential and Commercial," Form No. E30.

B. Construction Panels:

1. Plywood: DOC PS 1, unless otherwise indicated.
2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
3. Factory mark panels according to indicated standard.

C. Structural Use Panels for Backing: For mounting electrical or telephone equipment, provide fire-retardant treated plywood panels with grade, C-D Plugged Exposure 1, in thickness indicated or, if not otherwise indicated, not less than 15/32 inch thick.

2.06 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacturer.

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc-coating per ASTM A153 or of Type 304 stainless steel.
2. Where carpentry is exposed to pressure-preservative treated wood, provide fasteners of Type 304 or 316 stainless steel.
3. Nails, Brads, and Staples: ASTM F 1667.
4. Power-Driven Fasteners: NES NER-272.
5. Wood Screws: ASME B18.6.1.
6. Lag Bolts: ASME B18.2.1.
7. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers.

B. Screws for Fastening to Non-Structural Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

C. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing in accordance with ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.07 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber resilient insulation, fabricated in strip form, for use as a sill sealer; 1 inch nominal thickness, compressible to 1/32 inch; selected from manufacturer’s standard widths to suit width of sill members indicated.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

A. Carefully lay out, fit, and fabricate all items of rough carpentry. Use only treated, sound thoroughly seasoned materials of longest practical lengths and sizes to minimize joints. Use materials free of warp, unless warp can be easily corrected by anchorage and attachment. Brace, plumb, and level all members, and secure with sufficient nails, spikes, bolts, or other suitable fastenings to assure rigidity and permanent attachment.

1. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
2. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction

C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. "Table 2304.10.1 – Fastening Schedule" of the Ohio Building Code.

D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated. Install fasteners without splitting wood; predrill as required.

E. Use hot-dip galvanized or stainless steel nails where rough carpentry is exposed to weather, on ground contact, or in area of high relative humidity.

F. Apply field treatment complying with AWPA M4 to cut surfaces of preservative treated lumber and plywood.

G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous self-adhered polymer modified separator between wood and metal decking.

3.02 WOOD NAILERS AND BLOCKING

A. Install wood grounds, nailers, blocking and sleepers where shown and where required for screeding or attaching other work. Install in accurate locations and elevations for attachment of other materials, plumb and level, accurately aligned, cut and fit. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach to substrates to support applied loading. Recess bolts and buts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement. Provide wood blocking between studs at height of door stop, behind stop, at door openings in stud framing.

C. Install permanent grounds of dressed, preservative-treated, key beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds where no longer required.

D. Provide wood bucks around window and mechanical openings as required, sized so flanges will cover buck.

1. Anchor to walls and partitions with 3/8 inch bolts.
2. Verify flange dimensions with concerned trades.

E. Install appropriate concealed blocking, headers, and supports, to receive fixtures, accessories and similar items mounted on gypsum board partitions as may be required.

F. Provide concealed blocking and framing to support facing accessories, countertops, equipment, fixtures, specialty items, trim and facing materials.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

3.03 INSTALLATION OF STRUCTURAL-USE PANELS

A. Comply with applicable recommendations contained in APA Form No. E30, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Plywood Backing Panels: Nail or screw to supports.

END OF SECTION

SECTION 06 16 53

MOISTURE-RESISTANT SHEATHING BOARD

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes fiberglass-mat faced, moisture and mold resistant gypsum sheathing board attached to metal studs wall framing at exterior wall assemblies.

B. Related Sections:

1. Section 05 40 00 – Cold-Formed Metal Framing
2. Section 06 10 00 – Rough Carpentry
3. Section 07 21 00 – Thermal Insulation
4. Section 07 27 26 – Fluid-Applied Membrane Air Barrier applied over gypsum sheathing.

1.02 REFERENCES

A. ASTM International (ASTM):

1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
2. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
3. ASTM C 1002 Standard Specifications for Steel Drill Screws for application of Gypsum Board.
4. ASTM C 1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
5. ASTM C 1396 Standard Specification for Gypsum Board.
6. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
7. ASTM E 84 Test Method for Burning Characteristics of Building Materials.
8. ASTM E 119 Test Methods for Fire Tests of Building Construction and Materials.

B. Gypsum Association (GA): GA-253 Recommended Specifications for Application of Gypsum Sheathing

1.03 DEFINITIONS

A. Gypsum Board Construction Terminology Standard: Refer to ASTM C11 and GA-505 for definitions of terms for gypsum board sheathing board construction not defined in this section or in other referenced standards.

1.04 ACTION SUBMITTALS

A. Prepare submittals per requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature on products handling, storage, and installation (cutting and fastening) requirements to be used under this Section, clearly marked and fully described and as required under material exposure warranty.

C. Product Certificates: Submit performance data showing compliance with article Quality Assurance.

1.05 PERFORMANCE REQIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or GA-600, "Fire Resistance Design Manual."

1.06 QUALITY ASSURANCE

A. Qualifications: Provide materials and methods tested for required fire separations and moisture resistance, installed in accordance with this specification and the requirements of local building officials.

B. Single Source Responsibility: Except where specified otherwise, obtain gypsum board products, joint treatment, and accessories from single manufacturer or from manufacturers recommended by prime manufacturer of gypsum board products.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to project site with manufacturer's labels intact and legible. Fire-rated materials shall bear testing agency label and fire classification numbers intact and legible. Handle materials with care to prevent damage.

B. Stack boards off the ground, under cover, stacked flat, and fully protected from the weather. Stack sheathing board such that long lengths are not over short lengths and so that air is free to circulate. Store adhesives in a dry area protected from freezing.

1.08 PROJECT CONDITIONS

A. Environmental Requirements: Comply with manufacturer's written requirements under which products can be installed.

1. Maintain minimum 50 F surface and ambient temperature for 48 hours before and continuously until joint treatment and bonding adhesives are thoroughly dry.
2. Do not apply when ambient temperature to exceed 95 F.
3. Avoid drafts during dry, hot weather to prevent too rapid drying.

1.09 COORDINATION WITH OTHER TRADES

A. Installation Precautions: Follow manufacturer’s installation instructions including the following:

1. For installation of surface applied flashings, trim and membrane waterproofing flashing, coordinate locations of concealed blocking and nailers for full support of applied materials with structural stud installer.
2. For in-place exposure up to six-months, fill all gaps resulting from cuts, corners, joint and machine cuts with manufacture’s recommended exterior caulking at time of erection, except where water and air barrier follows installation within manufacturer’s acceptable exposure limitations.
3. Within 30 days of sheathing installation cover the sheathing with specified water and air barrier.

1.10 SEQUENCING AND SCHEDULING

A. Sequence installing sheathing with installing exterior cladding to comply with requirements indicated below:

1. Do not leave paper-surfaced gypsum sheathing board exposed to weather for more than 30 days.
2. Do not leave glass-mat gypsum sheathing board exposed to weather for more than 180 days.

1.11 WARRANTY

A. Special Warranty: Prepare and submit in accordance with Section 01 77 00.

1. Warrant installed product exposed to weather to be without failure, when installed in accordance with manufacturer’s requirements, for period of not less than 12 months.
2. Warrant installed products incorporated into exterior wall assembly systems for period of not less than 10 years.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Water-Resistant Gypsum Sheathing: Fiberglass-mat faced gypsum sheathing, ASTM C1177.

1. Thickness: 5/8 inch.
2. Width: 4 feet.
3. Length: Maximum permissible lengths.
4. Type X for fire-rated and typical assemblies.
5. Flame Spread: ASTM E84: 5 maximum; Smoke Developed: ASTM E84: 0.

6. Edges: Square.
7. Surfacing: Fiberglass mat on face, back, and long edges.
8. Racking Strength (Ultimate, not design value) (ASTM E72): Not less than 654 pounds per square foot, dry.
9. Flexural Strength, Parallel (ASTM C473): 80 lbf, parallel.
10. Compressive Strength: minimum 500 psi
11. Humidified Deflection (ASTM C1177): Not more than 2/8 inch.
12. Permeance (ASTM E96): Not less than 23 perms.
13. R-Value (ASTM C518): 0.67.
14. Mold Resistance (ASTM D3273): 10, in a test as manufactured.
15. Microbial Resistance (ASTM D6329, UL Environmental GREENGUARD 3-week protocol): Will not support microbial growth.
16. Surface burning characteristics (per ASTM E84): 0/0

B. Acceptable Products and Manufacturers:

1. DensGlass Fireguard Exterior Sheathing, Georgia-Pacific, Atlanta, GA
2. GlasRoc Sheathing, Certainteed Gypsum, Tampa, FL.
3. e^2XP Extended Exposure Sheathing, National Gypsum, Charlotte, NC.
4. Securock Glass-Mat Sheathing, USG, Chicago, IL.

2.02 ACCESSORY MATERIALS

A. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch thick, attach sheathing to comply with ASTM C 1002.

B. Glass-Fiber Sheathing Tape for Glass-Mat Gypsum Sheathing: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads per inch, of type recommended by sheathing manufacturer for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

1. Products: Provide one of the following:

   a. No. 8086 Contractor Sheathing Tape: 3M Contractor Products.
   b. Perma-Tite Tape – PGM 207A: PermaGlas-Mesh, Inc.
   c. POLYKEN 612 Seam Seal Tape: Polyken Technologies.
   d. Quik-Tape: Quik-Tape, Inc.

C. Miscellaneous Materials: Provide all incidental and accessory materials, tools, equipment, and methods required for satisfactory completion of gypsum sheathing board, including the following:

1. Sealant for Glass-Mat Gypsum Sheathing: Product complying with ASTM C834, compatible with sheathing tape and gypsum sheathing, recommended by sheathing and tape manufacturer for use with glass-fiber sheathing tape and for covering exposed fasteners.
2. Building Paper: ASTM D226, Type 1 non-perforated asphalt felt.

D. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.025 inch.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
   b. Grace Construction Products, a unit of W. R. Grace & Co. – Conn.; Vycor Plus Self-Adhered Flashing.
   c. Polyguard Products, Inc.; Polyguard 300.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine metal framing to ensure concealed blocking and nailers are in place, and that framing is ready for installation of sheathing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved. Commencement of work constitutes acceptance of conditions.

1. Check framing for accurate spacing and alignment, and within tolerances required by sheathing manufacturer.

3.02 INSTALLATION

A. General: Except as otherwise indicated, comply with manufacturer's instructions, GA-253, and the following for the installation of gypsum sheathing.

1. Cut boards using manufacturer’s approved method at penetrations, edges and other obstructions of the work; fit tight against abutting work, except provide a 3/8 inch setback where non-loadbearing construction abuts structural elements.
2. Coordinate installation of sheathing with installation of flashing, joint sealers and water and air barrier installation so that these combined materials are installed in the sequence and manner which prevents exterior moisture from passing through completed exterior gypsum assembly to the interior.
3. Apply fasteners so that screw heads bear tightly against face of gypsum sheathing boards, but do not cut into substrate.

B. Installation of Sheathing: Apply sheathing in longest lengths as practicable with orientation of boards running in manufacturer’s approved direction, either vertically or horizontally and with smooth face to exterior.

1. All finish edges shall occur centered over flanges of metal framing; staggering of joints in adjacent rows is not required, unless required to achieve component wind resistant data submitted as part of system design. Minimum gage for framing shall not be less than following”
2. At end joints; bring end joints into contact with each other without forcing. Cut and fit snugly around all openings.
3. Fasten sheathing to metal framing with specified fasteners. Drive fasteners in field of panel first, working toward ends and edges. Space fasteners max. 12” o.c. for walls and soffits with perimeter fasteners at least 3/8 inch from edge and less than 5/8 inch from ends and edges with framing at maximum 24” o.c. for walls and 12” for soffits. Drive screws so heads are flush with surface.
4. Seal sheathing joints according to sheathing manufacturer’s instructions and as follows.

    a. Apply elastomeric sealant on joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
    b. Apply sealant to end joints and intersections of sheathing and structure to provide watertight seal.

5. Do not attach sheathing to head tracks if track and studs can move independently; verify construction.
6. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
7. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.

3.03 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturers written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches, except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over weather-resistant building paper at bottom and sides of openings.
4. Lap weather-resistant building paper over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.04 COORDINATION WITH AIR BARRIER

A. Mandatory Requirements: Treat cut and raw edges of exterior gypsum sheathing with flexible flashing membrane at end of each day's installation to prevent exposure to moisture in accordance with Section 07 27 26.

B. Joint Seam and Terminations: Refer to Section 07 27 26 for requirements.

3.05 PROTECTION

A. Project gypsum sheathing that will be left exposed to the weather for more than one month as follows:

1. Protect cutouts, corners, and joints in the sheathing by filing with a flexible sealant or by applying sheathing tape recommended by sheathing manufacturer at the time sheathing is applied.
2. As an alternative to sealant/tape application, cover exposed exterior surface of sheathing with an air infiltration barrier. Anchor covering with metal lath securely fastened through sheathing to framing. Apply covering immediately after sheathing is installed.

END OF SECTION

SECTION 06 40 23

ARCHITECTURAL WOODWORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes shop fabricated and finished items of woodwork and casework including:

1. Shop fabricated and finished architectural casework including:

   a. Wood veneer faced cabinets
   b. Plastic laminate faced cabinets.

2. Hardware and accessories
3. Standing and running trim
4. Shop finishing architectural casework
5. Wood furring, blocking, shims, and hanging strips for installing architectural casework unless concealed within other construction before casework installation.
6. Field Installation of casework.

B. Related Sections include the following:

1. Section 01 43 30 – Mockups
2. Section 06 10 00 – Rough Carpentry for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
3. Section 06 61 16 – Solid Surface Fabrications
4. Section 09 22 16 – Non-Structural Metal Framing for framing, sheet metal anchor plates, and gypsum board substrate for woodwork installation.
5. Section 09 91 00 – Painting

1.02 DEFINITIONS

A. Architectural casework includes wood furring, blocking, shims, and hanging strips for installing casework items unless concealed within other construction before casework installation.

B. Exposed Surfaces: Casework surfaces visible after installation with doors and drawers closed. Other locations considered to be exposed include wall hung woodwork bottoms more than 40 inches above the floor and visible members in open cases or behind clear glass doors.

1. Other locations considered to be exposed include wall hung woodwork bottoms more than 40 inches above the floor and visible members in open cases or behind clear glass doors.

C. Semi-Exposed Surfaces: Casework members behind opaque doors, including shelves, divisions, interior faces of ends, case backs, drawer sides, backs and bottoms and back face of doors. Tops of cases 6'-6" or more above the floor shall be considered semi-exposed.

D. Concealed Surfaces: Sleepers, web frames, dust panels and other surfaces not usually visible after installation.

1.03 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product indicated, including cabinet hardware and accessories.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, details, attachment devices, and other components.

1. Comply with AWS Section 1 Submittals.
2. Submit one copy of Shop Drawings to AWI Quality Certification Program for review.
3. Show details full size.
4. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

5. Show locations and sizes of cutouts and holes for outlets and technology and other items installed in architectural casework.
6. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

D. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.

1. Shop-applied transparent finishes.
2. Shop-applied opaque finishes.
3. Solid surfacing

E. Samples for Verification:

1. Lumber with transparent finish, not less than 50 sq. in. for each species and cut, finished on one side and one edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
3. Veneer-faced panel products with transparent finish, 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.

    a. Furnish step sample of finish on panel.

4. Lumber and panel products with shop-applied opaque finish, 50 sq. in. for lumber and 8 by 10 inches for panels, for each finish system and color, with half of the exposed surface finished.
5. Corner pieces as follows: Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
6. Exposed cabinet hardware and accessories, one unit for each type and finish.
7. Corner pieces as follows:

    a. Cabinet front frame joints between stiles and rail, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
    b. Miter joints for standing trim.

F. Maintenance Data: Submit solid polymer manufacturer's care and maintenance and cleaning instructions. Include in Project close-out documents.

G. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Fabricator of products.

C. Registration of Project: Upon award of the contract, register the cabinetwork project with AWI and pay the appropriate fees.

D. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production and installation of interior architectural woodwork with sequence-matched wood veneers and wood doors with face veneers that are sequence matched with woodwork.

E. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards" (AWS) adopted and published jointly by Architectural Woodwork Institute, Architectural Woodwork Manufacturers Association of Canada, and Woodwork Institute for grades of interior architectural woodwork, construction, finishes, installation, and other requirements.

1. Provide AWI Quality Certification Program labels and certificates indicating that woodwork, including shop drawings and installation, complies with requirements of grades specified.
2. The Contractor, upon award of work, shall register the work under this section with the AWI Quality Certification Program (800-449-8811).

F. Prefabrication Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 – Project Management and Coordination.

1.05 MOCK-UPS

A. Mock-ups: Before fabricating and installing architectural woodwork, build mockups for approval of quality under provisions of Section 01 43 30 – Mockups. Mock-ups shall demonstrate aesthetic effects and qualities of materials and execution.

B. Mockups: Build mockups of both the plastic laminate faced casework and wood veneer faced casework including countertops to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution as follows:

1. Build mockups of one base cabinet, one wall-hung cabinet, and one countertop. Base cabinet shall have at least one drawer. Mockup shall be of the material and finish to be provided.
2. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
3. Notify Architect seven days in advance of dates and times when mockups will be installed.
4. Demonstrate the proposed range of aesthetic effects and fabrication.
5. Obtain Architect's approval of mockups before starting architectural woodwork fabrication.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.08 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

B. Mechanical/Electrical Coordination: Coordinate as required.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General: Provide materials that comply with requirements of AWS's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Lumber Standards: Comply with applicable provisions for grading and workmanship of AWI Quality Standards, Sections 100-T-1, 100-T-4, 100-T-5, Grade I and the requirements shown and specified, where standards conflict the more stringent shall apply. Provide lumber surfaced 4 sides (S4S) and fabricated to profiles shown. All lumber shall be kiln dried to the moisture content indicated in AWI Section 100-T-11.

C. Wood Species and Cut for Transparent Finish: AWI Grade I; Select white (sapwood) Whie Oak; rift sawn.

D. Wood Veneer Flitches: AWI Grade AA; (sapwood) rift sawn White Oak

E. Hardwood for Opaque Finish: AWI Section 100-T-1, Grade 2. Any hardwood which, when finished, will not show any grain, imperfection or other surface defects when used with the opaque finish specified.

F. Hardwood for Concealed Framing and Blocking: AWI Section 100-T-1, Grade II or III, any species

G. Standing and Running Trim: Provide standing and running trim of the sizes, profiles, species and finish as specified or shown for “Wood Species for Transparent Finish”.

H. Core Material : Interior grade, medium density fiberboard (MDF) complying with ASTM D1037 and ANSI A208.2-2002, premium Grade 140 MDF.

1. Density: Minimum of 48 pounds per cubic foot.
2. Screw Holding Using 1#10 Sheet Metal Screw:

a. Face: Not less than 300 lbs.
b. Edge: Not less than 225 lbs.

3. Thickness: As specified under Fabrication.

I. Core Material for Countertops with Sinks: Exterior grade, moisture, mold and mildew resistant, medium density fiberboard (MDF) complying with ASTM D1037 and ANSI A208.2-2002.

J. Hardboard: Tempered wood fiber hardboard, not less than 1/4 inch thick; S1S per ANSI-AHA 135.484 (American Hardboard Association).

K. Plywood shall have a grade-trademark identifying each plywood panel by type, grade and conformance with U.S. Product Standard PS 1-83 for Construction and Industrial Plywood.

1. Typical Plywood: APA rated in accordance with PS 1; 3/4 inch thick AC exterior grade unless indicated or specified otherwise; touch sanded where plastic laminate veneers are to be applied.
2. Hardwood Veneer Plywood (Indicated for Paint Finish): States Industries (Eugene, OR 800-843-2753) "Apple Ply"; Grade A, 1/16 inch alder veneer core; (9 ply for 1/2 inch thickness, 13 ply for 3/4 inch thickness); White Oak veneer faces, plain sliced.
3. Panels used for concealed parts may be C-D grade.
4. Thickness and application details as shown on the drawings.
5. Products manufactured with added urea-formaldehyde resins or assembled with laminating adhesives containing added urea-formaldehyde resins are prohibited.

L. Plastic Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Brands and colors as scheduled on drawings
2. Exposed: NEMA LD-3; general and vertical grade
3. Backing Sheets: NEMA LD-3; backing grade; undecorated

2.02 WOOD CABINETS FOR TRANSPARENT FINISH (AWS SECTION 10)

A. Quality Standard: Comply with AWS requirements for wood cabinets.

B. AWI Grade: Premium.

C. AWI Type of Cabinet Construction: Type A Frameless; Flush overlay style.

D. Wood Species and Cut for Exposed Surfaces: See “MATERIALS.”

1. Grain Matching: Run and match grain vertically for drawer fronts, doors, and fixed panels.
2. Matching of Veneer Leaves: Slip match.
3. Vertical Matching of Adjacent Veneer Leaves: End match.
4. Veneer Matching within Panel Face: Balance match.
5. Note: No edge tape shall be allowed. Edge banding on veneer surfaces shall be minimum 1/4” thick solid wood.
6. Comply with veneer and other matching requirements indicated on drawings.

E. Materials for Semi-exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Veneer-faced panel product (plastic laminated veneer plywood), Natural White Maple, flat cut.

2. Drawer Sides and Backs: Solid-hardwood lumber, Natural White Maple, flat cut.
3. Drawer Bottoms: Hardwood plywood matching sides and back.

F. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

G. Adjustable Shelves:

1. Adjustable shelves shall be minimum 3/4 inch thick or as indicated in details; plywood panel product where indicated.
2. All side and back edges of panel products shall be banded with hardwood lumber.
3. All front exposed edges of panel products shall be banded with solid wood.

a. All shelves to be adjustable on 1-1/4 inch centers.

H. Toe Kicks: Fixed cabinet bases shall be constructed of ¾-inch thick multi-ply premium grade panel product with 2x4 fir stringers. Bases shall be leveled and anchored to the floor in continuing lengths to ensure straight and true lines of casework.

I. Doors in panel products require hardwood edge for securing butt hinges.

2.03 PLASTIC LAMINATE FACED CASEWORK (AWS SECTION 10)

A. Quality Standard: Comply with AWS requirements for laminate faced cabinets.

B. AWI Grade: Premium.

C. AWI Type of Cabinet Construction: Type A Frameless; Flush overlay style.

D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard. Refer to Schedule of Interior Materials and Colors on Drawings.

E. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Vertical Surfaces: Grade VGS.
3. Edges: Grade VGS.
4. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

F. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.

a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.

2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.

2.04 ARCHITECTURAL CASEWORK HARDWARE

A. **(0640 H):** Provide architectural casework hardware and accessory materials associated with architectural cabinets and other architectural woodwork fabrications. Obtain architectural woodwork hardware for each category from a single manufacturer. Specified manufacturers and their product catalog numbers establish the standard of quality and design required for the various categories, and equivalent products by other

manufacturers may be acceptable, subject to Architect's review of their equivalency. Comply with BHMA A156.9 except as otherwise specified; provide the following items, or their approved equal, as required.

1. Frameless Concealed Cabinet Hinges (European Type) For 3/4 in Doors 24 inch or Less in Width: BHMA A156.9, B01602, 120 degrees of opening, self-closing.

    a. Manufacturers:

        1) Grass 3000 Series, No. 383,
        2) Blum; CLIP series 170.
        3) Hafele “200 Series.
        4) Provide appropriate mounting plate.

    b. Hinge Quantity:

Door Height (Max.)	Door Width (Max.)	Hinges Per Door
30 in.	24 in.	2
30 in.	36 in.	3

    c. Where cabinet doors exceed the dimension in height or weight exceeds 20 lbs per door, provide hinge quantity as recommended by hinge manufacturer.

2. Piano Hinge (for access panels at Info Point, and gate at café): Stainless Steel
3. Pivot Hinge:

    a. Manufacturers:

        1) Pivot base measures approximately 1.25" in height by 1" in diameter at the top and 3/4" in diameter at the bottom. Made from solid brass, satin nickel finish.
        2) Pivot Hinge for large cabinet doors and full size doors. Made of solid brass with steel pins, satin nickel finish.

4. Keyhole Fastening Plate with Stand-Offs (mounting for boxes at Activity Wall):
5. Aluminum C-Channels:

    a. Manufacturers:

        1) Base Shoe for 1/2" Glass (screen panel at Café counter)
        2) Channel for 1/4” Substrate (boxes at Activity Wall)

6. Rim Locks (for doors and drawers):

    a. Manufacturers:

        1) Universal Cam Lock Body: Häfele No. 235.08.018 or equivalent of Timberline, National.
        2) Cylinder Rosette: #210.04.070; Nickel matte
        3) Lock Cylinder: Provide lock core keyed alike; nickel matte finish

7. Door Pulls:

    a. Manufacturers:

        1) EPCO No. BP03.5SN or equivalent; Galvanized steel bar pulls, satin nickel finish.

8. Roller Catch with Stop Angle (café gate)
9. Magnetic Touch Latches (Town Center doors):

    a. Manufacturers:

        1) Sugatsune ML-80

10. Drawer Slides: BHMA A156.9, B05091; full-extension, zinc-plated steel drawer slides with steel ball bearings, provide the following:

    a. Manufacturers:

        1) File Drawer Slides: "Model No. 9301 (Accuride) up to 150 lbs. and max.
        2) Box Drawer Slides (non-file drawer): "Model No. 3832C (Accuride) up to 100 lbs. max.

11. Built-In Shelving Supports: (drilled side supports) BHMA A156.9, B04013; metal:
    a. K & V #332, pin size 5/16 inch diameter by 7/16 inch long.
12. Adjustable Shelf Standards, Supports and Back Edge Book Stops:
    a. Standards and brackets: BHMA A156.9, B04102; with shelf brackets, B04112.
    b. Hanging Book Support: Schultz Shelving System RATIO Model HB22 bright steel galvanized, or similar.
13. Adjustable Shelf Pilaster Standards and Supports:
    a. Manufacturers: Knape & Vogt, or equivalent wall brackets and standards, rated 400 lbs. 16 ga. Steel with electro plated finish.
        1) Brackets: #182, 12 inch deep with top flange for anchoring to shelf.
        2) Standards: #82, longest available length to prevent splicing.
14. Grommets for Cable Passage through Countertops: 2-inch OD, satin chrome, molded-plastic grommets and matching plastic caps with slot for wire passage.
15. Counter Support Brackets: Manufacturer's standard shelf angle, welded construction:
    a. Hafele, or other approved, rated 1100 lbs. minimum; steel with gray primer.
    b. Fixed: Hebgo Bracket; Cat. No. Series 287.45.xxx, size to shelf depth.
    c. Provide continuous blocking at back of support brackets.
16. Drawer/Door Bumpers: Rubber mortised type on jamb and/or head and sill strike areas of cabinet doors; 4 for paired doors, 3 for single leaf doors.

B. Coat Hooks: Hafele No. 842.34.050 or equivalent; stainless steel with brush matte finish. Including mounting screws. Provide twelve (12) hooks to be located as directed by Architect.

2.05 HARDWARE FINISHES

A. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
    1. Satin Stainless Steel, Stainless steel base: BHMA 630.
    2. Hinges: Nickel plated, matt finish.

B. Cabinet Drawer and Door Pulls at Plastic Laminate Cabinetwork: Nickel plated matt “Zinc” handles, EPCO Bar Pull, satin nickel.

C. Cabinet Drawer and Door Pulls at Wood Cabinetwork: Nickel plated matt “Zinc” handles, EPCO Bar Pull, satin nickel.

D. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.06 METAL MATERIALS

A. Stainless Steel:
    1. ASTM A240: Provide the most suitable austenitic alloy, form and finish required to produce the Work. Provide Type 304 or Type 316 and low carbon Type 304L or 316L for components to be welded, unless otherwise noted.
    2. Plate and Sheet: ASTM A480 , Stretcher level sheets

2.07 CASEWORK FABRICATION

A. Woodwork Grade: Provide AWS Premium-grade casework complying with referenced quality standard.
    1. Provide wood veneers only within the range of the accepted samples, including providing select veneers if required to remain within that range.
    2. Fabricate wood casework with wood veneer over medium density particle board. Provide solid wood edging at veneer panels.

3. Provide openings in casework for the incorporation of all electrical and mechanical components. Openings for all plumbing equipment shall be cut from templates obtained from the plumbing equipment installer.
4. Provide concealed access to casework electrical fixtures and wiring.
5. Unless indicated or approved otherwise, provide adjustable base to provide level installation which accommodates variations in floor levelness.
6. Shop assemble casework to the greatest practical extent.
7. Adjustable Shelves: All casework shelves shall be adjustable, unless otherwise noted.
8. Provisions for shelf adjustment shall be by drillings at 2 inches on center in the cabinet body for the placement of shelf support brackets. Provide 4 supports for each shelf. Drillings shall be in straight even lines.
9. Provide all hardware, fasteners, and exposed trim.
10. Fabricate Plastic Fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the drawings.
11. Provide openings with wiring grommets at locations indicated. When not indicated, provide openings with wiring grommets along countertops with knee spaces underneath. Space at 36 inches maximum, with a minimum of one opening per knee space.
12. Medium density particle board shall be minimum ¾ inch thick, minimum 1 inch thick where detailed.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 inch thick or Less: 1/16 inch.
2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.
3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

2.08 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.

1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Fire-Retardant-Treated Lumber and Engineered Wood Panels by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (engineered wood panels). Use the following treatment type:

1. Interior Type A: Low-hygroscopic formulation.

2. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
3. Kiln-dry materials before and after treatment to levels required for untreated materials.

2.09 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Structural Supports: Angle steel, minimum 0.125-inch thickness and sized to provide concealed support for countertops, lavatory tops, ledges, and other woodwork fabrications. Fully weld angles and braces into a single support, and pre-drill holes for anchors into building structure and into woodwork.

C. Glass and Glazing: Fully tempered glass as specified in Section 08 80 00 – Glazing.

D. Adhesive for Bonding Plastic Laminate: Contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.10 FASTENERS AND ANCHORAGES

A. Anchors: Type, size, material and finish as required for the condition of use capable of sustaining, without failure, the load imposed within a safety factor of 4 as determined by tested in accordance with ASTM E448. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

B. Fasteners:

1. Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1 for applicable requirements. For metal framing supports, provide screws as recommended by metal-framing manufacturer.
2. Nails: FS FF-N-105, type, size, material and finish as required for the condition of use.

C. Panel Clips: Aluminum interlocking offset panel fasteners; type, size and quantity for the condition of use. Provide one of the following or approved equal:

1. "Panel "Z" Clips" (Monarch Metal Fabrications Inc.).
2. "ZC3 Clips" (Doug Mockett & Co., Inc.).

D. Blind Splines and Draw Downs: Specialty devices, as required for tight butt joining, types and size as recommended by woodwork fabricator. Where mortises of fastener heads, or drawdowns are exposed (blind holes) in finished work, provide plastic cover caps, color as selected by Architect.

2.11 SHOP FINISHING (AWS SECTION 5)

A. Grade: Provide finishes of same grades as items to be finished. Comply with AWS, Section 5.

B. General: Finish architectural casework at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural casework, as applicable to each unit of work.

1. Before finishing, all exposed portions of woodwork shall have handling marks or effects of exposure to moisture removed with a thorough, final sanding over all surface of exposed portions, using appropriate grit sandpaper, and shall be cleaned before applying sealer of finish.
2. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling, woodwork on or adjacent to exterior walls, and to end grain surfaces.
3. Gluing of face veneers shall, where possible, be by the hot plate method; glued surfaces shall be in close contact throughout. Glue stains will not be permitted.
4. Grain of all transparent finished wood shall run in the direction shown, or if not shown, as accepted on the shop drawings.

D. Transparent Finish; Exposed Surfaces:

1. AWS Grade: Premium.
2. Finish: Section 5 AWS Finish System 7, Catalyzed Vinyl for closed grain woods.
3. Sheen: Match Architect's sample.

E. Opaque; Exposed Surfaces:

1. AWS Grade: Premium.
2. Finish: Section 5 AWS Finish System 7, Catalyzed Vinyl for closed grain woods.
3. Color: As selected by Architect.
4. Sheen: Match Architect's sample.

F. Solid Surfacing Finish: As scheduled.

G. Unexposed Wood Finish: Shop-applied alkyd type primer-sealer.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence. Notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.

B. Do not begin installation until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of site conditions and responsibility for defective installation caused by prior observable conditions.

3.02 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.

B. Coordinate the installation of blocking and other supports required for the installation of architectural woodwork elements.

C. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.03 CASEWORK INSTALLATION

A. Installation Quality Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Coordinate casework installation with work of other trades for final electrical and mechanical connections.

D. Install casework level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

E. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts. Scribe casework to adjacent surfaces as follows:

1. Countertops and splashes to wall surfaces.
2. Cabinet end walls and other exposed surfaces to walls.
3. Cabinet bases to floors.

F. Anchor casework to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

G. The casework installation shall be made complete with all required fastenings, clip angles, braces, anchors, adjustable levelers, and other fittings as required to render the work rigid and secure.

H. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

I. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c.
3. Caulk space between backsplash and wall with sealant specified in Section 07 92 00 – Joint Sealants. Where there is no backsplash or where backsplash is of a different material from countertop, calk space between countertop and adjoining material.

J. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.04 STANDING AND RUNNING TRIM INSTALLATION

A. Jointing: Make all joints to conceal shrinkage; miter all exterior corners; cope all interior corners, miter or scarf all end-to-end joints; install all trim pieces as long as possible, jointing only where solid support is obtained. Make no joints closer than 4 feet to corners.

B. Lengths of Material: Use random lengths and show typical joint locations on shop drawings. The minimum length shall be 8 feet, except where short lengths are required by installation conditions.

C. Fastening:

1. Install all items straight, true, level, plumb, and firmly anchored in place; where blocking or backing is required, coordinate as necessary with other trades to ensure placement of all required backing and blocking in a timely manner.
2. Fasten trim with finish nails or screws of proper dimension to hold the member firmly in place without splitting the wood.
3. On exposed finish work, set all nails and screws.
4. Align exposed fasteners for uniform pattern; random or "shotgun" patterns will not be accepted.

D. Select and arrange standing and running trim so that abutting members have a similar grain and color match to the greatest extent possible.

3.05 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Install without distortion so that doors, and drawers, fit openings properly and are accurately aligned.

1. Adjust hardware to center doors, and drawers, in openings and to provide unencumbered operation.
2. Complete the installation of hardware and accessory items as indicated. Clean, lubricate, and adjust hardware.
3. Upon completion of work, and in the Architect's presence, demonstrate hardware to work freely as intended.

C. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork.

D. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

E. Review grommet locations with Owner and Architect prior to installation. Coordinate location with power/data jacks below the countertop.

F. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 06 61 16

SOLID SURFACE FABRICATIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Solid Surface Fabrications (SS_) including, but not limited to the following:

1. Public Areas/ Staff Areas/ Book/Av Checkout Counter/ Restrooms

B. Related Sections:

1. Section 06 10 00 – Rough Carpentry for plywood substrate, wood furring, blocking, required for installing solid surfacing and concealed within other construction before installation.
2. Section 06 40 23 – Architectural Woodwork
3. Schedule of Finishes on the drawings.

1.02 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For solid-surfacing material.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for plumbing fixtures installed in the work.

1.03 QUALITY ASSURANCE

A. Fabricator /Installer: Approved by the solid surface manufacturer with not less than 3 years documented experience in fabrication installation of solid surface components of the type required for the project.

B. Installer: Installation of solid surfacing materials shall be by a firm that is authorized by the manufacturer to fabricated and install the material.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver solid surfacing until painting and similar operations that could damage sills have been completed in installation areas. If sills must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.05 PROJECT CONDITIONS

A. Coordination: Submit related shop drawings, specified in another Section simultaneously for approval.

B. Field Measurements: Where sills are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace solid surfacing that fail to perform in accordance with their published specifications due to manufacturing defects under normal use.

1. Warranty Period: 10 years.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Solid Surfacing Material (Drawing designation **SS_)**

1. Basis-of-Design: Subject to compliance with requirements, provide either the product listed in the "Schedule of Finishes" or a comparable product by one of the following manufacturers:

   a. DuPont, Inc.
   b. Formica Corporation
   c. LG Hausys
   d. Wilsonart International, Inc.

2.02 SOLID SURFACING MATERIALS

A. Material: Homogeneous solid sheets of filled acrylic resin complying with ISFA 2-01.

1. Superficial damage to a depth of 0.010 inches shall be repairable by sanding and polishing.
2. Windowsills: 1/2 inch thick, adhesively joined with inconspicuous seams; edge details as indicated.

   a. Color: Schedule of Finishes on the drawings.

2.03 UNDERLAYMENT

A. All horizontal solid surface shall have an underlayment of plywood. Particleboard as an underlayment is prohibited.

1. Adhere solid surface to the underlayment with 100 percent silicone adhesive.

2.04 ACCESSORIES

A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch-sanded.

B. Adhesives: As recommended by the manufacturer. Adhesives shall not contain urea formaldehyde.

2.05 FABRICATION

A. Fabricate sills in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate sills with shop-applied edges of materials and configuration indicated.
2. Joints shall be flush sealed with joint adhesive where required. Provide seam block under all seams in accordance with manufacturer's instructions. Ease top and front edges and corners.
3. Fabricate to field measurements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates indicated to receive sills and conditions under which sills will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install sills level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Secure sills with adhesive according to solid surface manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match sill, form seams to comply with solid surface manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Bond seams with seam adhesive and draw tight as sills are set. Mask areas adjacent to joints to prevent adhesive smears.

D. Apply sealant to gaps at walls; comply with Section 07 92 00 – Joint Sealants.

3.03 ADJUSTING AND CLEANING

A. Clean all solid surfacing, immediately after installation.

B. Remove and replace sills of the following description:

1. Broken, chipped, stained, or otherwise damaged material.
2. Defective sills.
3. Defective joints, including misaligned joints.

C. Provide temporary covers and protect installed work until final acceptance.

END OF SECTION

SECTION 07 01 50

PREPARATION FOR RE-ROOFING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes preparation of existing roof areas for reroofing. Work includes:

1. Preparation of existing roofing for new roof overlay system.

B. Related Sections:

1. Section 01 11 00 – Summary of Work for use of the premises and phasing requirements.
2. Section 01 50 00 – Temporary Facilities and Controls for temporary construction and environmental-protection measures for reroofing preparation.
3. Section 07 54 00 – Thermoplastic Polyolefin Roofing: New roofing system.

1.02 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

B. Existing Membrane Roofing System: Roofing membranes (various types), roof insulation, surfacing, and components and accessories between deck and roofing membrane.

C. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and reinstalled.

D. Existing to Remain: Existing items of construction that are not indicated to be removed.

1.03 ACTION SUBMITTALS

A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.

B. Core cuts

C. Fastener pull-out test report.

D. Qualification Data: Installer is to be approved by warrantor of new roofing system(s).

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Regulatory Requirements: The Contractor is solely responsible for complying with all relevant requirements of governing authorities. Comply with governing Federal EPA and State EPD notification regulations before starting roof demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Reroofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect; Owner's insurer if applicable; testing and inspecting agency representative; roofing system manufacturer's representative; roofing Installer including project manager, superintendent, and foreman; and installers whose work interfaces with or affects reroofing including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to reroofing including, but not limited to, the following:

a. Reroofing preparation, including membrane roofing system manufacturer's written instructions.
b. Temporary protection requirements for existing roofing systems that are to remain during and after installation.
c. Existing roof drains and roof drainage during each stage of reroofing, and roof drain plugging and plug removal requirements.
d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

e. Condition and acceptance of existing roofing membrane and base flashing substrate for re-use.
f. Structural loading limitations of deck during reroofing.
g. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that will affect reroofing.
h. Governing regulations and requirements for insurance and certificates if applicable.
i. Existing conditions that require coordination before proceeding.

1.05 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately below reroofing area. Conduct reroofing so Owner's operations will not be disrupted. Provide Owner with not less than 72 hours' notice of activities that may affect Owner's operations.

B. Protect building to be reroofed, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

D. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.

E. Limit construction loads on roof to rooftop equipment wheel loads and for uniformly distributed loads.

F. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

1.06 COORDINATION

A. Coordinate roofing work as it relates to work going through the roof deck and/or affecting the roof deck and/or the roof system. Perform roofing work in strict accordance with the various roofing material manufacturer's installation instruction requirements and recommendations.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 EXAMINATION

A. Inspect substrates and conditions under which the work of this section will be performed, and verify that construction operations may properly commence. Do not proceed with the work until unsatisfactory conditions have been fully resolved.

B. Verify that all drain lines are unblocked before starting work. Any blocked drains shall be cleared before starting work. Cover all drains and other openings intended for roof drainage with screens to prevent clogging of the drainage system. During construction, allow for sufficient drainage to prevent ponding with possible structural overloading.

C. Closely inspect any uncovered condition and alert Architect’s representative to conditions which may interfere with the performance of the new roof membrane system, inclusive of flashings.

D. All roofing work shall be performed in a way to provide a water tight roof system at all times during construction. It is the Contractor's responsibility to prevent construction-related leaks.

3.02 TEMPORARY FACILITIES

A. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to building and facilities to remain.

1. Provide protection to ensure safe passage of people around and below work areas. Orange barricade fencing is required at egress doors, around staging areas and ground level work areas.
2. Provide temporary weather protection, during exposure of existing roofing membrane to weather, to prevent water leakage and damage to structure and interior areas.

3.03 PREPARATION

A. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

B. Have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

C. At existing drain locations, assure functionality of drain and drain components. Where clamp rings and strainers are broken or missing, replace with new components. Plastic drain strainers, if any, shall be replaced with cast iron drain strainers.

D. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.

1. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new membrane roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing membrane roofing system components that are to remain.

E. Protection of surfaces: Take every precaution to prevent water leakage, or debris falling into the building interior, or other such occurrences. Contractor is responsible for any and all damage to the building interior or its contents that occur as a direct cause of the Work and due to the Contractors methods and mean practice to accomplish the Work required herein.

F. Conduct reroofing operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of the public using the building.

1. Protect existing site improvements, appurtenances, and landscaping to remain.
2. Protect all trees, shrubs and vegetation.
3. Protect existing paved areas. Do not allow heavy equipment to operate on these areas.
4. Protect all grass areas and restore to original condition where damaged by storage or equipment.

3.04 UTILITY SERVICES

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Rooftop equipment which is scheduled to be deleted, changed and/or raised per requirement of project specifications/drawings, shall be completed according to local and state building code requirements and completed by licensed Contractors.

C. Existing Services/Systems to be temporarily Removed or Relocated: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to facilitate reroofing work

1. Building maintenance engineer will arrange to shut off services/systems, when possible, upon request of Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.05 EXISTING ROOFING MEMBRANE PREPARATION

A. Confirm with roofing systems manufacturer requirements for preparation of existing roofing assembly to receive recover with cover board (recover) and new adhered TPO roofing membrane.

B. Verify that roof surface is visibly dry and free of moisture. Examine existing roof deck, if broken or loose fasteners that secure decking to one another or to structure are observed or if deck appears or feels inadequately attached, immediately notify Architect.

C. The roof membrane to receive the new roofing recover shall be even, without protrusions of any kind. If deck surface is not suitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect.

D. Provide additional deck securement as required to proper installation of roofing membranes and in accordance with roofing manufacturer's requirements.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Building thermal insulation and accessories, including but not limited to the following:

1. Thermal batt insulation between wall framing at exterior walls
2. Rigid board thermal insulation on exterior walls.
3. Rigid insulation at perimeter foundation walls
4. Rigid insulation used in other construction assemblies
5. Batt and semi-rigid batt insulation for thermal applications.
6. Sound attenuation insulation in wall and ceiling construction.
7. Low pressure, low expansion polyurethane foamed-in-place insulation / air barrier sealant: applied to seal gaps, cracks, cavities and joints in the building envelope, at door frames, perimeter of window frames, and other similar penetrations in exterior walls.
8. Sill Sealer

B. Related Sections:

1. Section 04 22 00 – Concrete Unit Masonry
2. Division 07 Roofing Sections: Insulation in roofing assemblies.
3. Section 09 29 00 – Gypsum Board: Sound attenuation insulation.
4. Division 23, Mechanical: Insulation for ducts, heating, air conditioning, ventilating, and plumbing work shall be furnished and installed by the respective Mechanical Contractor.

1.02 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

1. Product Data: Manufacturer's product data sheets, specifications, performance data, physical properties for each item furnished hereunder.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility: Furnish each insulation type from one manufacturer for entire Project, unless otherwise acceptable to Architect.

B. Insulation Thermal Properties: Thermal resistance R-values indicated are values at 75 degree mean temperature. Where insulation is identified by R-value, provide thickness required to achieve indicated R-value. Foam plastic insulation R-values are “aged” thermal values in accordance with RIC/TIMA conditioning procedure.

C. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products in accordance with test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.

D. Foam plastic insulation: Foam plastic insulation cores, coatings and facings shall meet the following classification requirements when tested in accordance with ASTM E84.

1. Exterior walls: Flame spread rating of 25 or less; smoke developed rating of 450 or less.

1.04 DELIVERY, STORAGE AND HANDLING

A. Insulation shall be legibly marked with the following data:

1. Its "R" value per inch and the mean test temperature
2. The manufacturer's name

3. The insulation type and its tradename
4. Water vapor transmission (perm inch average)
5. UL rating – flame spread, fuel contribution, smoke developed (ASTM E84 and D1692)

B. Deliver insulation materials in manufacturer's original, unopened, and labeled packages.

C. Provide adequate protection for all materials stored on site and after installation. Protect insulation from physical damage, and from becoming wet and soiled.

D. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Rigid insulation board (extruded polystyrene):

a. DuPont de Nemours, Midland, MI.
b. Owens-Corning Co., Parsippany, NJ.
c. Kingspan Insulation NA, Atlanta, GA

2. Glass Fiber Batt Insulation:

a. CertainTeed Corp., Valley Forge, PA
b. Owens-Corning, Toledo, OH
c. Knauf Insulation, Shelbyville, IN
d. Johns Manville, Denver, CO

3. Mineral Fiber Batt Insulation:

a. Rockwool
b. Thermafiiber

4. Low pressure polyurethane foamed-in-place insulation / air barrier sealant:

a. Fomo Products, Inc., Norton OH.
b. Dupont, Midland, MI.
c. Premier industrial Supply, Phoenix AZ.
d. Convenience Products, Division of Clayton Corp., Fenton MO.
e. Henry Company, El Sequndo CA.

2.02 INSULATION MATERIALS

A. Provide insulating materials that comply with requirements and with referenced standards; sized to fit applications indicated, selected from manufacturer’s standard thickness, widths, and lengths.

B. Batt Insulation: Unfaced; Glass or other inorganic fibers and resinous binders formed into flexible batts or blankets.

1. Glass Fiber Insulation (typically in exterior walls and ceilings as indicated on drawings): Flame resistant thermal glass batt/blanket type insulation.

a. Unfaced: ASTM C665,Type I
b. Thermal Resistance: ASTM C518, R Value of 3.2 per inch of thickness at 75 F mean temperature.
c. Fire Rating: ASTM E84, Flame spread 25 or less and smoke development 50 or less.
d. Acceptable Products:

1) Commercial Blanket Insulation, CertainTeed Corp.
2) Unfaced Commercial Insulation, Johns Manville.

3) Unfaced Light Density Thermal Insulation, Owens Corning.

C. Mineral-Wool Blanket Insulation, Unfaced**:** ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

1. Nominal Density: 2.4 lb/cu. ft.
2. Thermal Resistivity: Not less than 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F
3. Flame-Spread Index: Not more than zero when tested in accordance with ASTM E84.
4. Smoke-Developed Index: Not more than zero when tested in accordance with ASTM E84.
5. UL Classification Code: BZJZ
6. Basis-of-Design Product: ROCKWOOL (Roxul, Inc.); Safe'n'Sound or comparable product by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Thermafiber, Inc.; an Owens Corning company.
c. Owens-Corning

D. Cavity Wall Insulation (Rigid Insulation): Extruded polystyrene, square edges. Polyisocyanurate board not permitted.

1. Not manufactured using chlorofluorocarbons (CFCs) and maximize use of recycled material.
2. Thickness or Thermal Resistance (R-Values): As scheduled; value determined at not less than 6 months after manufacture.
3. Classification: ASTM C578, Type X.
4. Fire Rating: ASTM E84, 1 inch thick test material, flame spread 10 or less, smoke development 200 or less.
5. Acceptable Products:

a. GreenGuard CM by Pactiv.
b. Styrofoam Cavitymate by DuPont.
c. Foamular by UC Industries (Owens Corning).

E. Extruded Polystyrene Board Insulation: Rigid closed-cell, polystyrene thermal board insulation formed from polystyrene base resin by an extrusion process using hydrochlorofluorocarbons as blowing agent to comply with ASTM C578 for type and with other requirements indicated below:

1. Foundation Perimeter Walls: 2 inches thick; R=10.0 (Basis of Design: DuPont "Styrofoam Brand Score Board")
2. Exterior Wall (Under Gypsum Board): 2 inches thick; R=10.0

a. Type IV, density of 1.6 lb/cu ft. minimum density.
b. Surface-burning characteristics: Maximum flame spread and smoke-developed indices of 75 and 450, respectively.
c. Recycled Content: Not less than 50 percent blend of post consumer and recovered polystyrene resins.
d. Acceptable Products:

1) GreenGuard CM by Pactiv.
2) Styrofoam Cavitymate by DuPont.
3) Foamular by UC Industries (Owens Corning).

F. Safing Insulation: Comply with ASTM C665, Type 1, unfaced; manufacturer's standard sizes, thickness as indicated; lengths and widths required to interface with size of space insulated.

1. Provide manufacturer's standard galvanized steel safing impaling insulation clips and brackets.
2. Materials shall be rated non-combustible as defined by NFPA when tested in accordance with ASTM E136.
3. Standard: United States Gypsum Co., Chicago, IL "Thermafiber SAFB" or approved equal.

G. Foam-In-Place Insulation:

1. Polyurethane Foam Insulation (Minimal Expansive) for Window and Door Perimeters: Single or two-component, UL classified sealant, to insulate, seal, fill, and stop air infiltration; shall not expand to the point to cause pressure on window and door jambs.

a. Density: ASTM D 1622, 1.0 - 1.8 lbs./cu. ft.
b. R-Value: ASTM C 518, not less than 4.0 per inch of thickness.
c. Fire-Test-Response Characteristics: ASTM E 84, as follows:

1) Flame Spread: Not greater than 25.
2) Smoke Developed: Not greater than 50.

d. Manufacturers and Products:

1) Dow Chemical Company (The); Great Stuff PRO Window & Door.
2) Fomo Products Inc.; Handi-Seal Window and Door Sealant.
3) Convenience Products; No-Warp Foam Window & Door Insulating Sealant.

2.03 SOUND ATTENUATION INSULATION

A. Sound Attenuation Batts: Glass or other inorganic fibers and resinous binders formed into flexible batts or blankets, complying with ASTM C665, Type I unfaced, manufacturer's standard sizes, thickness as indicated; lengths and widths required to interface with size of space insulated, maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, passing ASTM E 136 for combustion characteristics; and of the following nominal density and thermal resistivity:

B. Fiberglass Sound Attenuation Blankets:

1. Material Quality Standard: ASTM C 665, Type I.
2. Description: Unfaced blankets produced by bonding inorganic glass fibers with a thermosetting binder.
3. Surface Burning Characteristics: According to ASTM E 84/NFPA 255/UL 723:

a. Flame Spread: Class A no greater than 25.
b. Smoke Developed: No greater than 50.

4. Thickness: As indicated.
5. Manufacturers and Products:

a. CertainTeed Corporation; CertaPro AcoustaTherm Batts.
b. Johns Manville Building Insulation Div.; Sound Control Batts.
c. Knauf Fiber Glass; QuietTherm.
d. Owens Corning; Sound Attenuation Batts.

2.04 AUXILIARY INSULATING MATERIALS

A. Rigid Board Adhesives: Provide insulation manufacturer's recommended adhesives for sealing joints and bonding insulation to substrates shown. Adhesives shall be compatible with insulation materials secured.

B. Tape: Self-adhering pressure sensitive, compatible with insulation, foil type recommended by manufacturer of insulation.

C. Impaling Fasteners: Impale clip of galvanized steel, with steel spindle or prong type pins with washers, mechanically fastened to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place. Verify acceptability of anchors with insulation manufacturer.

1. Manufacturers/products:

a. Stic-Klip Mfg. Co., "Stic-Klip."
b. Miracle Adhesives Corp., "Stuck Up."
c. H. A. Jones, "Insul-Anchors."
d. Pyrotek, “Install Pins”

D. Metal Furring Channels: Screw-type, 24 gauge galvanized steel Z-furring members, 2 inch depth, designed for mechanical attachment of rigid thermal insulation to masonry walls.

1. Fasteners: Manufacturer's recommended fastenings to suit substrate and application indicated.
2. Standard: USG Z-Furring Channels.

E. Supplementary Support: Galvanized steel hexagonal wire mesh where required for supplementary support of insulation in permanent proper location. Provide manufacturer's recommended fasteners.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare surfaces and areas to receive insulation material as required by the manufacturer. Do not install materials in unsatisfactory areas or to improperly prepared surfaces.

B. Verify substrate and conditions under which insulation work is to be performed. Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Verify substrate surface is clean, flat, dry, free of irregularities, and ready to receive insulation materials.

D. Verify insulation boards are dry, unbroken, and free of damage.

3.03 INSTALLATION – GENERAL

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Coordinate application of insulation with the appropriate building trades involved.

C. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

D. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:

1. Use blanket widths and lengths that fill cavities formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. For wood-framed construction with faced blankets having stapling flanges, position insulation to produce 1/2-inch continuous air space between insulation facing and inner surface of concealing finish material, unless otherwise indicated. Secure insulation by inset, stapling flanges to sides of framing members.

E. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where surface is otherwise insulated. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

F. The installer doing the insulation work shall furnish adhesives or attaching means, if required, so that insulation material will be properly held in alignment and permanently attached to the surfaces which they are to be applied without damaging surface.

1. Install insulation that is undamaged, dry, unsoiled, and has not been exposed at any time to ice and snow.

G. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

1. Apply single layer of insulation to product thickness indicated.

3.04 INSTALLATION – RIGID BOARD INSULATION

A. Foundation Insulation: Install board insulation on foundation perimeter with adhesive in accordance with manufacturer's instructions.

1. Stagger board joints.

2. Butt edges and ends tight to adjacent board and to protrusions.
3. Extend boards over expansion joints, unbonded on one side of joint.

B. Cavity Wall Insulation: Install board insulation horizontally beginning at bottom of cavity.

1. Secure insulation with adhesive.
2. Stagger joints between courses.
3. Place boards in method to maximize contact bedding.
4. Butt edges and ends tight to adjacent board and to protrusions.
5. Cut and shape insulation with knife, handsaw, or other cutting tool as required to fit around penetrations, projections, and openings to accommodate conduit or other services.
6. Seal cut-outs with manufacturer's recommended sealant.

C. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

1. Bond with adhesive to vertical substrate. Stagger all joints. Butt edges and ends tight to adjacent board with no protrusions.
2. Protect insulation from displacement and damage during backfilling and slab placement.

D. Install boards on exterior walls vertically and hold in place with Z-furring channels spaced at maximum 24 inches on center.

1. Install panels and furring channels progressively starting at corner condition. Space furring channels not more than 12 inches from corner at interior corners and not more than 3 inches from corner at exterior corners.
2. Install insulation full height of wall. Stagger horizontal joints. Cut insulation to fit non-standard spaces. Bond with adhesive to vertical substrate.

3.05 INSTALLATION – BATT AND BLANKET INSULATION

A. Provide batt insulation where indicated and where the insulation is not part of another Specification Section. Install insulation after plumbing, mechanical, and electrical services have been installed.

B. Install mineral fiber blankets/batts in cavities formed by framing members according to the following requirements:

1. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends. Use batts free of damage and stagger butt joints.
2. Place blankets/batts in cavities formed by members to produce a friction fit between edges of insulation and adjoining framing members.
3. Provide mechanical fasteners, wire mesh, or other accessories to ensure insulation remains in specified position.
4. Fit insulation tight within spaces and tight to exterior side of plumbing, mechanical, and electric services within plane of insulation leaving no gaps or voids.
5. Cut and fit tightly around all obstructions and fill all voids around all cutouts for lights, cabinets, pipes and plumbing, HVAC ducts, electrical boxes, and other irregularities. Provide 3 inch clearance around non-IC recessed light fixtures unless lighting fixtures are rated for contact with insulation.
6. Install insulation within metal framing systems full height and width. Do not allow voids or openings to occur. Insulation is required for full width between studs, including cavity of each stud.
7. Cut insulation oversize to ensure tight butt joints when installed. Cut insulation to fit around protrusions and irregularly shaped projections.

C. Batt Insulation with Vapor Barrier: Friction fit between studs at exterior wall construction and secure in place to prevent sagging or settling.

1. Install insulation with factory applied barrier facing “warm-in-winter” side of building spaces.
2. Tape: Tape seal butt ends and lapped side flanges. Tape and seal tears and cuts in barrier.

D. Stuff glass fiber loose fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume (to a density of approximately 2.5 pcf).

3.06 INSTALLATION – ACOUSTICAL ASSEMBLIES

A. STC-Rated Assemblies: Comply with requirements of indicated assemblies in partition schedule.

B. Comply with recommendations of the Gypsum Association's Fire Resistance Design Manual, Section III, Sound Control.

C. STC-Rated Assemblies shall be airtight. Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations.

D. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

E. Coordinate installation of recessed fixtures, accessories and devices to minimize sound transmission pathways. Recessed fixtures, accessories and devices located on opposite sides of the same wall shall be offset such that they do not share the same stud cavity. Where field conditions require that recessed fixtures, accessories and devices be located within the same stud cavity, the back of such fixtures, accessories and devices shall be wrapped with Putty Pads. Recessed fixtures, accessories and devices located on opposite sides of the same metal stud wall shall not be attached to the same metal stud.

F. Do not install sound attenuation blankets until mechanical and electrical work within framing spaces is complete.

G. Install sound attenuation blanket in contact with one face of partitions scheduled to receive sound insulation. Install insulation with daubs of adhesive applied to back of gypsum board or with adhesive applied to edge of studs to maintain full coverage and prevent slumping at tops of partitions and other displacement. Sound insulated partitions shall be constructed, insulated and caulked so as to produce sound transmission coefficient rating (STC) indicated. Do not locate outlets, switches or similar items on opposing sides of partition within same stud space.

H. Fit sound attenuation blankets tight around cut openings and penetrations, and behind and around electrical and mechanical items within framing spaces. Pack blankets around door and window frames, between jamb studs, in boxed headers, and in other voids.

I. Where sound attenuation blankets are installed in partitions, seal perimeters, control and expansion joints, openings, and penetrations with continuous beads of acoustical sealant at both faces of partition.

1. Apply acoustical seals to electrical boxes and other penetrations of gypsum board

J. Where concealed acoustical sealant beads are required at floor line, apply sealant to clean floor surface first and set drywall boards into the sealant.

K. At other locations tool beads to ensure complete contact with joint surfaces. Where exposed, form smooth concave surface suitable for finish painting.

3.07 INSTALLATION – SAFING INSULATION

A. Install safing insulation in accordance with manufacturer's instructions to maintain fire separations indicated.

B. Install safing insulation of proper sizes and thickness with brackets or safing clips spaced as needed and not more than 24 inches on center. Fill safe-off area between floor slabs and exterior wall system components. Fill all voids. Provide continuity of fire safety systems as indicated.

3.08 FOAM INSULATION

A. Spray-Applied Foam Insulation: Apply spray-on insulation by certified applicators with pneumatic spray equipment, filling voids, cracks, and holes.

1. Fill spaces between multiple studs inaccessible to batt insulation.
2. Use in locations concealed by gypsum board only. Do not use in exposed locations.

3.09 PROTECTION

A. Protect installed insulation from harmful weather exposures and from possible physical abuses, where possible non-delayed installation of concealing work, or where that is not possible, by temporary covering or enclosure.

B. Seal all cuts, punctures and penetration of integral insulation vapor barriers with vapor barrier tape before installing surface finishes.

END OF SECTION

SECTION 07 26 16

BELOW GRADE VAPOR RETARDERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section included providing sheet membrane vapor retarders under concrete slabs-on-grade including all accessory items.

B. Related Sections:

1. Section 03 30 00 – Cast-In-Place Concrete
2. Section 31 00 00 – Earthwork

1.02 REFERENCES

A. ASTM International:

1. ASTM E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
2. ASTM E1643: Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

B. Technical Reference - American Concrete Institute (ACI):

1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
2. ACI 302.1R-15 Guide to Concrete Floor and Slab Construction.

1.03 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 30 00 – Submittal Procedures.

B. Information and Review Submittals:

1. Product Data: Manufacturer's product data sheets, specifications, performance data, physical properties for each item furnished hereunder.
2. Manufacturer’s Instructions: Manufacturer’s installation instructions for placement, seaming and pipe boot installation.

C. Quality control/assurance submittals:

1. Summary of test results per paragraph 9.3 of ASTM E1745.
2. Manufacturer’s samples and literature.
3. Manufacturer’s installation instructions for placement, seaming, penetration prevention and repair, and perimeter seal per ASTM E1643.
4. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.

1.04 DELIVERY, STORAGE AND HANDLING

A. Take precautions to prevent puncturing, tearing and damage to vapor retarder.

1.05 COORDINATION

A. Section 31 00 00 for compacted subgrade under vapor retarder, fully compacted and complete.

B. Section 03 30 00 – Cast-in-Place Concrete

C. Division 22 and Division 26 for penetrations through vapor retarder.

1. Penetrations through the vapor retarder shall be coordinated and sequenced to allow proper flashing and sealing of all penetrations prior to placement of concrete.
2. Penetrations through the vapor retarder shall be flashed and sealed prior to placement of concrete.
3. Utility penetrations through the vapor retarder shall be a minimum of 12-inches apart.

1.06 WARRANTY

A. Warranty: Compliance with the designated ASTM E1745 classification, and no manufacturing defects in the product for, at least, the life of the building.

PART 2 – PRODUCTS

2.01 UNDER SLAB VAPOR RETARDERS

A. Basis of Design manufacturer and product:

1. Specified Product (Basis of Design): To establish a standard of quality, design and function desired, Drawings and specifications have been based on Stego Industries LLC company, San Clemente, CA.
2. Product: “Stego Wrap Vapor Barrier (15 mil)”.

B. Acceptable manufacturers and products:

1. Fortifiber, El Segundo, CA
   a. Product: ““Moistop Ultra 15”
2. Reef Industries, Houston, TX,
   a. Product “Griffolyn -15 Mil Green”.

C. Performance requirements:

1. Maintain permeance of less than 0.01 Perms [grains/(ft^2 /hr/inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
2. Minimum thickness: 15 mils.
3. Water Vapor Permeance ASTM F1249 – Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor: 0.0086 perms.
4. Tensile Strength ASTM D882 – Test Method for Tensile Properties of Thin Plastic Sheeting: 70.6 lbf/in
5. Puncture Resistance ASTM D1709 – Test Method for Impact Resistance of Plastic Film by Free-Falling Dart Method: 2,266 grams

2.02 ACCESSORIES

A. General: Tapes, adhesives and fasteners required for the proper and complete installation for work of this Section shall be as recommended by each respective manufacturers of each type of vapor barrier.

B. Pressure Sensitive Tape, Seam Splice Tape Primer, Boots, and Other Accessories: As instructed by manufacturer for watertight impermeable underslab retarder.

C. Perimeter edge seal: Termination bar or recommended sealing tack tape by vapor retarder manufacturer.

D. Vapor barrier safe concrete accessories by vapor retarder manufacturer.

1. Beast Screed by Stego Industries, LLC, (877) 464-7834 www.stegoindustries.com.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify installation conditions as satisfactory to receive work of this Section.

1. Underslab Utilities: Drain lines and utilities properly installed and ready for work of this Section.
2. Through-Slab Penetrations: Ready for work of this Section.

B. Verify subgrade is compacted, smooth, level and free from conditions that may cause puncture or other damage to vapor retarder.

3.02 PREPARATION

A. At slabs on grade, rake and level irregular subgrades within a tolerance of 1/2 inch and then re- recompact.

3.03 INSTALLATION – BELOW-SLAB VAPOR RETARDERS

A. General: Install Vapor Barrier in accordance with manufacturer's instructions and ASTM E 1643. Place vapor barrier beneath all floor slabs. Install vapor retarder sheet over compacted capillary break material.

B. Unroll Vapor Barrier with the longest dimension parallel with the direction of the pour and with minimum number of joints.

C. Lap vapor retarder over footings, turn up to full slab thickness, and seal with pressure sensitive tape to foundation walls.

D. Overlap joints a minimum of six inches with top lap in direction of spreading concrete. Turn up double layer at slab edges abutting walls. Seal with manufacturer's tape.

E. Seal pipe penetrations (including pipes, reinforcing steel, and permanent utilities) with vapor retarder or prefabricated boots and pressure sensitive tape. Field fabricate boots and other shapes as necessary to seal vapor retarder against vapor penetration.

F. Do not puncture vapor barrier. No punctures or unsealed penetrations are permitted.

G. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

H. Place concrete slab-on-grade directly over installed vapor retarder under work of Section 03 30 00. Do not install granular fill layer over vapor retarder.

3.04 FIELD QUALITY CONTROL

A. Contact vapor barrier manufacturer to schedule a pre-construction meeting and to coordinate a review, in-person or digital, of the vapor barrier installation.

B. Inspect competed installation prior to placing concrete slab-on-grade.

C. Verify vapor retarder installed in accordance with manufacturer's instructions with penetrations taped and sealed.

D. Verify that vapor retarder has not been penetrated by screed stakes and that base set screed posts are in place.

3.05 ADJUSTMENTS

A. Patch penetrations with pressure sensitive tape and make adjustments as necessary to maintain performance of vapor retarder as instructed by manufacturer.

B. Repair damaged areas by cutting vapor retarder patches. Overlap tears and holes 6 inch beyond damaged area with patches. Seal patch to installed vapor retarder with pressure sensitive tape or as instructed by manufacturer.

C. Promptly patch tears and punctures as they occur. Do not patch or seam when vapor retarder is wet.

3.06 PROTECTION

A. Protect From Penetration: Do not permit use of ground set stakes, screed posts, and other items to puncture vapor retarder. Where punctured, remove penetrating item and patch vapor retarder, as specified this Section, before placing concrete.

B. Lay plywood or other protection board over installed vapor retarder at areas of heavy traffic and other construction loads. Do not stack construction materials directly on vapor retarder.

END OF SECTION

SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIER

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes a vapor-permeable system of fluid applied coatings to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

B. Related Sections include the following:

1. Section 06 16 53 – Moisture Resistant Sheathing Board.
2. Section 07 62 00 – Sheet Metal Flashing
3. Section 07 92 00 – Joint Sealants: Joint-sealant materials and installation

1.02 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air and acts as a waterproof weather-resistive barrier.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.03 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E2357.

1.04 ACTION SUBMITTALS

A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

C. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1. Include details of interfaces with other materials that form part of air barrier.
2. Include details of mockups.

1.05 INFORMATIONAL SUBMITTALS

A. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

C. Qualification Data: For Applicator.

1.06 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance and that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly, 150 sq. ft. (14 sq. m), incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.

1. Coordinate construction of mockup to permit inspection of air barrier before external insulation and cladding is installed.
2. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
1. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site.

1. Include installers of other construction connecting to air barrier, including roofing, waterproofing, architectural precast concrete, masonry, sealants, windows, glazed curtain walls, and door frames.
2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.09 WARRANTY

A. Special Manufacturer’s Warranty: Manufacturer’s standard form in which manufacturer agrees to replace air barrier material that does not comply with requirements or fails to for specified barrier within specified warranty period.

1. Warranty does not include failure of air barrier membrane due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch in width.
2. Warranty Period: Five years from the date of Substantial Completion.

B. Special Installer’s Warranty: Standard form, signed by Installer, covering Work of this Section for a warranty period of two years.

1. Warranty includes removing and reinstalling cladding, finish panels, and overburden on surfaces the air barrier is installed upon.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Henry Company; Air-Bloc 31/ Air-Bloc 33

B. Acceptable Manufacturers/Products: Subject to compliance with requirements, provide basis of design or comparable products of one of the following.

1. Carlisle Coatings & Waterproofing Inc.; Barritech VP.
2. DuPont; Tyvek Fluid Applied WB+ System.
3. GE/Momentive Performance Materials; SEC2500 SilShield AWB.
4. GCP Applied Technologies, Inc., Perm-A-Barrier VPL.
5. Prosoco;R-Guard Cat 5 or R-Guard MVP.
6. Sto Corp; Sto AirSeal.
7. Tremco Incorporated, an RPM company; ExoAir 230.

2.02 FLUID-APPLIED MEMBRANE AIR BARRIER

A. Source Limitations: Supply primary air-barrier materials and air-barrier accessories from single manufacturer.

B. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric synthetic polymer membrane.

1. Basis of Design: Henry Company; Air-Bloc 31 or Air-Bloc 33
2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Vapor Permeance: Minimum 5.5 perms; ASTM E 96/E 96M.
c. Ultimate Elongation: Minimum 100 percent; ASTM D 412, Die C.
d. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
e. Membrane shall pass testing for “Nail Sealability” –ASTM D1970

C. Liquid-applied flashing for all window, door, MEP penetrations, inside/outside and dissimilar material connections shall be Air-Bloc LF manufactured by Henry; a moisture-curing single component STPe liquid-applied flashing compatible with a variety of substrates and all Henry liquid and self-adhered air barrier membranes. Liquid-flashing shall have the following physical properties:

1. Elongation: minimum 250% minimum to ASTM D412.
2. Tensile Strength: 132% psi minimum to ASTM D412.
3. Nail Sealability: Pass to AAMA 711.
4. VOC Content: 25 g/L max.
5. Solids Content by Volume: 95%.
6. Moisture Absorption: 0.1% to ASTM D570

2.03 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid primer recommended for substrate by manufacturer of air barrier material.

C. Counterflashing Strip: Modified bituminous, 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 32 mils (0.8 mm) of rubberized asphalt laminated to an 8-mil- (0.2-mm-) thick, crosslaminated polyethylene film with release liner backing.

D. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, 0.0250 inch thick, and Series 300 stainless-steel fasteners.

E. Butyl Strip: Vapor-retarding, 30- to 40-mil- (0.76- to 1.0-mm-) thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.

F. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.

G. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

H. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

I. Adhesive-Coated Transition Strip: Vapor-permeable, 17-mil- (0.43-mm-) thick, self- adhering strip consisting of an adhesive coating over a permeable laminate with a permeance of 37 perms (2145 ng/Pa x s x sq. m).

1. Product: Henry's Blueskin Breather, or equal.

J. Through-wall Flashing Membrane: SBS modified bitumen, self-adhering type, integrally laminated to a glass scrim reinforced aluminum foil film.

1. Product: Henry's Foilskin.

K. Joint Sealant: ASTM C920, single-component, neutral-curing silicone; Class 100/50 (low- modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 07 92 00.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate per manufacturer instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjacent and adjoining surfaces including storefront and glazing and other prefinished materials that are to remain in the completed work.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Concrete and Masonry: Prepare, treat, rout, and fill open joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer recommendations. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

H. Sheathing:

1. Joints and gaps to 1/4 inch width may be filled with sealant if acceptable to air barrier manufacturer.
2. Seal cut edges that receive air barrier per membrane manufacturer’s recommendations.

I. Cover gaps in substrate plane and form smooth transitions from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier membrane.

1. Contractor Option: Self-adhesive stainless steel flashing.

J. Bridge isolation joints, deflection joints, expansion joints, and discontinuous wall-to-wall, deck- to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer recommendations and details.

3.03 ACCESSORIES INSTALLATION

A. Install accessory materials according to air-barrier manufacturer recommendations and details to form air- and water-tight seals with adjacent construction for continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that minimum 3 inches of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal air-barrier membrane continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that minimum 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to ensure adhesion.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with closed-cell foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, transition strip.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.04 AIR BARRIER MEMBRANE INSTALLATION

A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions and details.

B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

C. Apply primer to substrates, where recommended by manufacturer, at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
2. Apply primer to all areas to receive transition sheet and / or through-wall flashing membrane, as indicated on drawings by roller or spray and allow minimum 30 minute open time.

D. Transition Sheet:

1. Position self-adhered transition membrane and remove protective film. Press firmly into place. Ensure minimum 2" overlap at all end and side laps.
2. Promptly roll all laps with a counter top roller to effect seal.
3. Ensure all preparatory work is complete prior to installing Air-Bloc 33.

E. Through-wall Flashing Membrane (Self-Adhering Type)

1. Align and position the leading edge of self-adhering through-wall flashing membrane with the front horizontal edge of the foundation walls or self angles, partially remove protective film and roll membrane over surface and up vertically.
2. Press firmly into place. Ensure minimum 2” overlap at all end and side laps.
3. Promptly roll all laps and membrane to effect the seal.
4. Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.
5. Apply through-wall flashing membrane along the base of masonry veneer walls, over windows, doors and all other wall openings. Membrane shall form continuous flashing and shall extend up a minimum of 8-inches up the back-up wall.

F. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions.

1. Vapor-Permeable Membrane Air Barrier: 120-mil (3.0-mm) wet film thickness.

G. Apply strip and transition strip a minimum of 1 inch (25 mm) onto cured air membrane or strip and transition strip over cured air membrane overlapping 3 inches (75 mm) onto each surface according to air barrier manufacturer's written instructions.

H. Do not cover air barrier until it has been tested and inspected by Owner's testing agency substrates and reapply air barrier components.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E 783.

3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer recommendations, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer recommendations.

F. Prepare test and inspection reports.

3.06 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 30 days.
2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION

SECTION 07 42 13

FORMED METAL WALL PANELS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concealed clip lap-seam metal wall panels.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.03 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Sample Warranties: For special warranties.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.07 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.08 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 METAL WALL PANELS

A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Flush Metal Panel (**MWP1**):

1. Product and Manufacturer:

a. Basis of Design: Morin Corp. Concealed A-12-0 12” wide panels with ½ inch reveal.

2. Panel Material: Aluminum-Zinc Alloy Coated Steel Sheet: ASTM A792, AZ50

a. Face Sheet: Minimum 0.030 inch/22 gage (0.76 mm) nominal uncoated thickness.

1) Surface: Smooth
2) Panel Coverage: 12 inches
3) Panel Depth: 1.50 inches
4) Panel Joint: Tongue and groove interlock type.
5) Panel Attachment: Concealed individual or continuous fixed negative pressure clip and fastener.

b. Exposed Coil-Coated Finish System:

1) Fluoropolymer Two-Coat System: 0.2 mil primer with 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA 621.

a) Basis of Design: Fluoropon Classic II.

2) Panel Exterior Surface: Seafoam Green Metallic
3) Interior Surface: Manufacturer's standard primer color

C. Corrugated Metal Panel (MWP2):

1. Product and Manufacturer: CENTRIA, Exposed Fastener Series Metal Wall Panels

a. Basis of Design: CENTRIA Econolap ¾ inch; CENTRIA Architectural Systems.

2. Panel Material: Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Class Z275), structural steel.

    a. Face Sheet: Minimum 0.030 inch/22 gage (0.76 mm) nominal uncoated thickness.

        1) Surface: Smooth and perforated
        2) Panel Coverage: 34.66 inches.
        3) Panel Height: 0.75 inches .
        4) Corrugation Spacing: 2.66 inches o.c.

    b. Exposed Coil-Coated Finish System:

        1) Fluoropolymer Two-Coat System: 0.2 mil primer with 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA 621.

            a) Basis of Design: CENTRIA Fluorofinish.

        2) Panel Exterior Surface: To be selected by Architect from manufacturer's standard colors.
        3) Interior Surface: Manufacturer's standard primer color

2.02 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

2.03 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.04 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.03 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.04 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 42 43

METAL COMPOSITE MATERIAL WALL PANELS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes aluminum-faced composite panels provided for both exterior assemblies with corresponding mounting systems. Panel mounting system including anchorages, furring, fasteners, gaskets and sealants, related flashing adapters and masking for a complete installation.

B. Related Sections:

1. Section 05 41 00 – Cold-Formed Metal Framing for secondary support framing supporting metal wall panels.
2. Section 07 21 00 – Thermal Insulation.
3. Section 07 62 00 – Sheet Metal Flashing for copings, flashings, and other sheet metal work not part of metal wall panel assemblies.
4. Section 07 92 00 – Joint Sealants for field-applied sealants not otherwise specified in this Section.

1.02 DEFINITION

A. Metal-Faced Composite Wall Panel Assembly: Metal-faced composite wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight wall system.

1.03 PERFORMANCE REQUIREMENTS

A. General Performance: Metal-faced composite wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft.

C. Water Penetration Under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

D. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects of gravity loads and loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592 and ASTM E 330 as applicable:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:

   a. Uniform pressure as indicated on Drawings.

2. Deflection Limits: Metal-faced composite wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/175 of the span at the perimeter and 1/60 of the span anywhere in the panel.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

1.04 ACTION SUBMITTALS

A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal-faced composite wall panel and accessory.

C. Shop Drawings: Show fabrication and installation layouts of metal-faced composite wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish among factory-, shop-, and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:

a. Flashing and trim.
b. Anchorage systems.

D. Samples for Initial Selection: For each type of metal-faced composite wall panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.
2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal-Faced Composite Wall Panels: Minimum 12 x 12 inches. Include fasteners, closures, and other metal-faced composite wall panel accessories.

a. Composite Panels: Include four-way joint.

2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: 12-inch- long Samples for each type of accessory.
4. Exposed Gaskets: 12 inches long.
5. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of metal-faced composite wall panels adjacent to joint sealants.

F. Coordination Drawings: Exterior elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Wall panels and attachments.
2. Girts.
3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
4. Penetrations of wall by pipes and utilities.

1.05 INFORMATIONAL SUBMITTALS

A. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

C. Field quality-control reports.

D. Maintenance Data: For metal wall panels to include in maintenance manuals.

E. Warranties: Samples of special warranties.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Source Limitations: Obtain each type of metal-faced composite wall panel from single source from single manufacturer.

A. Installer Qualifications: An employer of workers trained and approved by manufacturer, with at least 5 years' experience in work of this type.

1. Installer's responsibilities include fabricating and installing metal wall panel assemblies and providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Certified by metal-faced composite wall panel manufacturer to fabricate and install manufacturer's wall panel system.

1. Panel fabricator and installer shall assume undivided responsibility for all components of the exterior panel system, including but not limited to, attachment to sub-construction, panel-to-panel joinery, panel-to-dissimilar-material joinery and joint seal associated with the panel system.

C. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact joint sealants to joint-sealant manufacturers for testing indicated in subparagraphs below:

1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

    a. Perform tests under environmental conditions replicating those that will exist during installation.

2. Submit no fewer than nine pieces of each type of material, including joint substrates shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule enough time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical MCM panel assembly including corner, supports, attachments, and accessories.

E. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal-faced composite wall panel Installer, metal-faced composite wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal-faced composite wall panels including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal-faced composite wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal-faced composite wall panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal-faced composite wall panel assembly during and after installation.
8. Review wall panel observation and repair procedures after metal-faced composite wall panel installation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal-faced composite wall panels, and other manufactured items so as not to be damaged or deformed. Package metal-faced composite wall panels for protection during transportation and handling.

B. Unload, store, and erect metal-faced composite wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Store metal-faced composite wall panels vertically, covered with suitable weathertight and ventilated covering. Store metal-faced composite wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal-faced composite wall panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg F.

D. Retain strippable protective covering on metal-faced composite wall panel for period of panel installation.

1.08 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal-faced composite wall panels to be performed according to manufacturer's written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal-faced composite wall panel fabrication and indicate measurements on Shop Drawings.

1.09 COORDINATION

A. Coordinate metal-faced composite wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal-faced composite wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: One year from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal-faced composite wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 COMPOSITE FIRE RETARDANT METAL PANELS

A. General: Provide factory-formed and -assembled, metal-faced composite wall panels fabricated from two metal facings bonded, using no glues or adhesives, to solid, extruded fire-retardant thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight system.

1. Subject to compliance with requirements, but are not limited to, the following:

a. Basis of Design: Alpolic Materials; Mitsubishi Chemical
b. Reynobond; Arconic Architectural Products
c. Alucobond USA; 3A Composites.

B. Attachment System Components: Formed from material compatible with panel facing.

1. Include manufacturer's standard perimeter extrusions with integral weather stripping, panel stiffeners, panel clips and anchor channel.

2.02 PANEL MATERIALS

A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Aluminum-Faced Composite Wall Panels. Formed with 0.020-inch- thick, coil- aluminum sheet facings with finishes as noted below:
2. Panel Thickness: 0.236 inch
3. Core: Thermoplastic core material with inorganic fillers that meets performance characteristics specified when fabricated into composite assembly.
4. Face Sheets: Aluminum alloy 3105 H14 and as follows:

    a. Exterior Finish: Coil coated with a fluoropolymer paint finish that meets or exceeds values expressed in AAMA 2605 where relevant to coil coatings.

        1) **ACM1**: Alpolic Fr Core, Mzg Grey Mica Series 2 - 2-Coat Mica Finish
        2) **ACM2**: Alpolic Fr Core Mro Anthracite Grey Series 2 - 2-Coat Mica Finish.

5. Concealed Finish: Apply pretreatment and manufacturer's standard white or light- colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Fire Performance:

1. Flamespread, ASTM E84: Class A.
2. Smoke Developed, ASTM E84: Class A.
3. Surface Flammability, Modified ASTM E108: Pass.
4. Ignition Temperature:

    a. Flash, ASTM D1929: 716 degrees F (380 degrees C).
    b. Ignition: 752 degrees F (400 degrees C).

5. Flammability, Exterior, Non-load-bearing wall assemblies and panels, NFPA 285: Pass.

C. Panel Sealants:

1. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal-faced composite wall panels and remain weathertight; and as recommended in writing by panel manufacturer.

2.03 MISCELLANEOUS METAL FRAMING

A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G40 hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.

B. Zee Clips: 0.079-inch nominal thickness.

C. Base or Sill Angles: 0.079-inch nominal thickness.

D. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.04 MISCELLANEOUS MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated.

B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal-faced composite wall panels by means of plastic caps or factory- applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.05 ACCESSORIES

A. Wall Panel Accessories: Provide components required for a complete metal-faced composite wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets,

fillers, closure strips, and similar items. Match material and finish of metal-faced composite wall panels unless otherwise indicated.

B. Flashing and Trim: Formed from 0.018-inch- minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal-faced composite wall panels.

2.06 FABRICATION

A. General: Fabricate and finish metal-faced composite wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal-faced composite wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Metal-Faced Composite Wall Panels: Factory form panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.

1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
2. Fabricate panels with sharply cut edges, with no displacement of face sheets or protrusion of core material.
3. Fabricate panels with panel stiffeners, as required to comply with deflection limits, attached to back of panels with structural silicone sealant or bond tape.
4. Dimensional Tolerances:

    a. Panel Bow: 0.8 percent maximum of panel length or width.
    b. Squareness: 0.25 inch maximum.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat- lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal-faced composite wall panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal-faced composite wall panel manufacturer for application, but not less than thickness of metal being secured.

2.07 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable.

D. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal-faced composite wall panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal-faced composite wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal-faced composite wall panel manufacturer.
3. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal-faced composite wall panels to verify actual locations of penetrations relative to seam locations of panels before panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal-faced composite wall panel manufacturer's written instructions.

3.03 METAL-FACED COMPOSITE WALL PANEL INSTALLATION

A. General: Install metal-faced composite wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Commence metal-faced composite wall panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
2. Shim or otherwise plumb substrates receiving metal-faced composite wall panels.
3. Flash and seal metal-faced composite wall panels at perimeter of all openings. Do not begin installation until weather barrier and flashings that will be concealed by panels are installed.
4. Install flashing and trim as metal-faced composite wall panel work proceeds.
5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
6. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners:

1. Aluminum Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal-faced composite wall panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal-faced composite wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.

E. Attachment System Installation, General: Install attachment system required to support metal- faced composite wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
2. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.

F. Clip Installation: Attach panel clips to supports at each metal-faced composite wall panel joint at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and- returned flanges of wall panels to panel clips with manufacturer's standard fasteners.

1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 07 92 00 – Joint Sealants.

G. Track-Support Installation: Provide manufacturer's standard horizontal and vertical tracks that provide support and complete secondary drainage system, draining to the exterior at horizontal joints. Install support system at locations, spacings, and with fasteners recommended by manufacturer. Attach panels to wall by interlocking tracks with perimeter extrusions attached to wall panels. Fully engage integral gaskets and leave horizontal and vertical joints with open reveal.

1. Attach routed-and-returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
2. Attach flush wall panels to perimeter extrusions by engaging panel edges and by attaching with manufacturer's standard structural silicone adhesive.
3. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.

H. Rainscreen-Principle Installation: Provide manufacturer's standard pressure-equalized, rainscreen-principle system with vertical channel that provides support and complete secondary drainage system, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach wall panels by engaging horizontal support pins into notches in vertical channels and into flanges of wall panels. Leave horizontal and vertical joints with open reveal.

1. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.

3.04 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal-faced composite wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

C. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.05 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal-faced composite wall panel units within installed tolerance of 1/4 inch in 20 feet, nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.06 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal-faced composite wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal-faced composite wall panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.

B. After metal-faced composite wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal-faced composite wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 54 00

THERMOPLASTIC POLYOLEFIN ROOFING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes: Single-ply, fully adhered thermoplastic (TPO) membrane roofing system as a roof replacement system. System also includes the following:

1. Cover board above insulation.
2. Rigid roof board insulation beneath the roofing membrane.
3. Vapor Retarder/air barrier/temporary roofing membrane
4. Membrane flashings
5. Metal roof edging and copings
6. Flashing at all penetrations through the roofing system and at all materials which abut roofing system.
7. Roof walkways
8. Integration of roofing accessories into roof assembly which are specified in other sections.

B. Related Sections:

1. Section 01 50 00 – Temporary Facilities and Controls: Project conditions regarding temporary protection of roofing.
2. Section 06 10 53 – Miscellaneous Rough Carpentry: Wood nailers and blocking related to roofing system attachment.
3. Section 07 01 50 – Preparation for Re-Roofing: Removal of existing roofing system down to the structural roof deck and preparation of deck surface for new roofing.
4. Section 07 76 00 – Sheet Metal Flashing: Metal roof edge flashings, sheet metal flashings, and counter flashings and reglets.
5. Section 07 92 00 – Joint Sealants

1.02 DESCRIPTION OF ROOFING SYSTEM

A. General: Roof systems are indicated on drawings by types which correspond to the same types as listed below:

1. **RCA–A1 –** New 60-mil TPO membrane over 1/2 inch cover board and average 6 inch insulation, with tapered insulation. over vapor retarder/temporary roofing membrane over metal roof deck.

1.03 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's (National Roofing Contractors Association) "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

B. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's (Single-Ply Roofing Institute) "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.

C. Factored Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," after multiplication by a safety factor.

D. FM and FMG: Factory Mutual Engineering Corp. Publications include Property Loss Prevention Data Sheets and Approvals Guide.

1.04 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and flashings shall remain watertight.

B. Sheet Membrane Manufacturer's Responsibilities: Sheet membrane manufacturer shall be totally responsible for designing the roof assembly attachment systems.

C. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail Resistance Rating: MH.

E. Provide roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure. The roof system and system components shall comply with requirements in FM Approvals of 4450 and 4474, current editions.

1. Submit the RoofNAV number that hat shows that the roof of system complies with the performance requirements listed in the specification.

F. Wind Up-Lift and Hail Characteristics: Provide a membrane roofing system that is identical to systems that have been successfully tested in accordance with FM 4474 by a qualified testing and inspecting agency to resist uplift pressures and hail as listed below. The perimeter and corner areas shall be prescriptively enhanced in accordance with the current edition of FM Global Loss Prevention Data Sheet 1-29.

1. Corner Uplift Pressure: As indicated on Drawings.
2. Perimeter Uplift Pressure: As indicated on Drawings.
3. Field-of-Roof Uplift Pressure: As indicated on Drawings. Provide roofing assemblies, including anchorage, capable of withstanding wind pressures acting inward and outward normal to the plane of the roof.
4. Determine design loads using the appropriate coefficients for the roof configurations indicated.
5. Hail Resistance: SH

G. Flashings: Comply with requirements of Section 07 62 00 – Sheet Metal Flashing. Provide base flashings, perimeter flashings, detail flashings and component materials that comply with requirements and recommendations of the following:

1. FMG 1-49 Loss Prevention Data Sheet for Perimeter Flashings.
2. FMG 1-29 Loss Prevention Data Sheet for Above Deck Roof Components.
3. NRCA Roofing and Waterproofing Manual (2015 Edition) for construction details and recommendations.
4. SMACNA Architectural Sheet Metal Manual (Seventh Edition - 2012) for construction details.

1.05 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 30 00 – Submittal Procedures.

B. Product Data, Roofing Systems: Submit the name of the manufacturer and specification numbers and product names of all materials proposed for each type of product specified. Include in submittal installation instructions and general recommendations for each principal roofing system product required. Include data substantiating that the materials comply with requirements, including certificates and delivery logs for bulk materials.

C. Shop Drawings: Submit shop drawings showing roof size, including dimensions of roof perimeters and corners; details of flashing methods at parapet walls, penetrations, termination's, drains, method of seaming (machine and hand welding), location of seams, and other specified accessories.

1. Base, perimeter, and detail flashings, and membrane terminations.
2. Crickets, saddles, and tapered edge strips, including slopes.
3. Insulation supplier's shop drawings showing the layout of the insulation including slopes. Shop drawings shall show actual locations and sizes of all roof drains and other pertinent rooftop equipment.
4. Insulation fastening patterns.

D. Contract Closeout Submittal: Include the following at time of Project Closeout:

1. Submit the following and include in "Warranties Manual"

   a. Submit executed warranty.
   b. Submit written recommendations from roofing manufacturer covering maintenance program, frequency of periodic inspections, instructions on notification procedures to follow in the event a roof leak occurs, including emergency situations, and other warranty requirements which the Owner must comply with so as to not violate any terms or conditions required by the manufacturer.
   c. Submit copy of written report of final roofing inspection which took place prior to Substantial Completion; report shall indicate that repairs (if required) were made per roofing manufacturer's recommendations.

1.06 INFORMATIONAL SUBMITTALS

A. Prior to beginning the work of this section, roofing contractor shall provide a copy of the final System Assembly Letter issued by the manufacturer indicating that the products and system to be installed shall be eligible to receive the specified manufacturer's guarantee when installed by a certified contractor in accordance with our application requirements, inspected and approved by a manufacturer's technical representative.

B. Product Certificate: Submit notarized certificate, indicating complete list of products intended for use under Work of this Section, including product names and numbers and manufacturers' names, with statement indicating that products to be provided meet the requirements of the Contract Documents.

C. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

D. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

E. Qualification Data: For Installer and manufacturer, and manufacturer's technical representative.

F. Warranty Draft: Submit draft of warranty with required inclusion for review; warranty shall state obligations, remedies, limitations, and exclusions. Submit draft warranty with product data.

G. Inspection Reports: Copy of daily and final technical inspection reports of roofing installation.

1.07 QUALITY ASSURANCE

A. Source Limitations: Obtain components for membrane roofing system from or approved by roofing membrane manufacturer.

B. Installer's Qualifications:

1. Licensed or approved by manufacturer of thermoplastic membrane materials for installation of specified roof systems and issuance of special extended warranty as specified. Welding of seams shall be done by mechanics which have successfully completed a training course provided by sheet membrane manufacturer.
2. Installer must maintain a full time supervisor/foreman on job site during all times work is in progress. Supervisor must be certified to have had experience with applications similar in nature and scope to specified systems and have a minimum of ten (10) years' experience with type of roofing system specified and projects of this magnitude and scope.

C. Manufacturer's Technical Representative Qualifications: An authorized full-time employee representative of manufacturer experienced in the installation and maintenance of the specified roofing system and qualified to determine Installer's compliance with the requirements of this Project.

D. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
2. Interior Fire-Test Exposure: Class 1.

3. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

E. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Section 01 31 00 – Project Coordination. Review methods and procedures related to roofing system including, but not limited to, the following:

1. Review system requirements, including drawings, specifications, manufacturer's installation instructions and warranty requirements, including flashing details, special roofing details, and roof drainage. Resolve discrepancies prior to installation of roofing assemblies.
2. Review the requirements (contract documents), submittals, proposed installation schedule, location and storage of materials, requirements for inspections and testing or certifications, forecasted weather conditions, governing regulations, insurance requirements, proposed installation procedures, and any other items that may be required for completion of the project.
3. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
5. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
6. Establish those areas on the job site that will be designated as work and storage areas. Review schedule of material shipments, material storage and roof top loading.
7. Review structural loading limitations of roof deck during and after roofing.
8. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
9. Review governing regulations and requirements for insurance and certificates if applicable.
10. Review temporary protection requirements for roofing system during and after installation.
11. Review roof observation and repair procedures after roofing installation.

F. Roof deck fastener pullout test. Submit written evidence of the fastener pull-out or adhesive pull-off tests of deck and/or wall substrates(s), including the location of each test, shall be submitted prior to material shipments. The roof system manufacturer shall submit a written certification that the proposed fastener/adhesive will provide suitable pull-out/Pull-off resistance to meet the specified wind uplift rating.

1.08 DELIVERY, STORAGE AND HANDLING

A. General: Comply with requirements specified in Section 01 60 00 – Product Requirements.

B. Roofing membranes and insulation are to be stored in a dry trailer or inside a dry building. Exterior storage on skids or tarpaulin coverage is unacceptable. Store materials in their original undamaged and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

D. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

1. Roofing insulation which became wet before or after installation must be removed and replaced. Wet materials shall not be dried and reused. Wetted membrane materials must be thoroughly evaluated to determine the effect on adhesion, lap seals or blister potential. Remove any such material if there is any possibility of failure.

1.09 PROJECT CONDITIONS

A. Coordinate all roofing work closely with Architect as it relates to work going through the roof deck and/or affecting the roof deck and/or the roof system. Perform roofing work as identified in these project specifications and drawings, in strict accordance with the various roofing material manufacturer's installation instruction requirements and recommendations.

1. Comply with recommendations of the manufacturer for environmental conditions before, during, and after application of roofing system.

B. Inspect uncovered conditions and alert Architect to any condition which may interfere with the performance of the new roof membrane system, inclusive of flashings.

C. Rooftop equipment which is scheduled to be deleted, changed and/or raised per requirement of project specifications/drawings, shall be completed according to local and state building code requirements and completed by licensed Contractors. Deck replacement at location of equipment removal shall be included in base bid.

D. Roofing Contractor shall assist and cooperate with Owner and mechanical Contractor(s) as required to maintain the existing roof system, as well as the newly installed system, in a watertight condition throughout the construction period.

E. Remove all existing flashing components of the roof's perimeter and penetrations where existing flashing components interfere with the application of the new flashing materials. Clean existing surfaces of asphalt or other contaminants where contact with roof membrane surfaces is expected.

F. Sequence removal of existing roofing and installation of new roofing system to avoid unnecessary rooftop traffic over completed sections of new roofing. Where, due to work sequencing, traffic is required, traffic paths shall be clearly defined, and completed roofing shall be protected with plywood boards or similar material.

G. Weather: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements.

H. Coordination:

1. Coordinate with sheet metal contractor to ensure that metal counterflashing and pipe penetration flashing members are ready for installation.
2. Coordinate with trade responsible for safety line anchors to ensure that they have been installed prior to roofing.

I. Protection: Schedule and execute all work to prevent damage to adjacent surfaces not to receive roof coating materials. Provide full coverage of adjacent metal surfaces. Repair damage caused to existing substrates. Damage repair and cleaning performed at Contractor's expense. Provide necessary protection and avoid traffic on completed roofing work.

J. Protect the interior of the building against water damage at all times while the roofing repair work is in progress. Maintain roof drainage system during reroofing.

1.10 WARRANTY

A. Provide manufacturer's No Dollar Limit (NDL), non-prorated, Total Roofing System Warranty, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.

1. Special warranty includes roofing membrane, cover boards, membrane flashings, roofing accessories including adhesives, sealants, fasteners and plates, metal roof edgings, termination metals and roof drain assemblies and other components of membrane roofing system.
2. ROOFING AND FLASHING GUARANTY: The manufacturer(s) of materials used shall furnish a written twenty (20) year warranty on the complete roof installation. Submit the warranty in triplicate. The warranty shall begin when the project is completed and accepted by the Owner.
3. Submit a sample copy of roofing warranty which will be executed upon completion of the Work, prior to award of the contract.
4. All system components not specifically identified herein but required by the membrane supplier for the roof system installed by the Work required in the Project Manual shall be provided and included in the membrane supplier watertight warranty as required herein.
5. Warranty shall include roofing damage resulting from wind speeds up to and including 90 mph (3-second gust speed at 33 feet above ground for exposure category indicated).

B. Applicator/Roofing Contractor Warranty:

1. Applicator shall supply Owner with a separate workmanship warranty. In the event any work related to roofing, flashing, or metal is found to be within the Applicator warranty term, defective or

otherwise not in accordance with Contract Documents, the Applicator shall repair that defect at no cost to the Owner. Applicator's warranty obligation shall run directly to Owner, and a copy shall be sent to the roofing manufacturer.

2. Warranty shall cover, at no cost to the Owner, all labor and materials required to repair or replace roofing, flashings, sheet metal and copings as necessary to fully correct leaks, faulty workmanship or defective materials
3. Warranty period is 2 years after date of final acceptance of the project.

C. Existing Warranties: Warranties on existing building elements should not be affected by scope of work.

1. Installer is responsible for coordinating with Owner's representative to verify compliance.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer/Product: Provide roofing system of the following roofing materials manufacturer.

1. Carlisle Sure-Weld TPO

a. Thickness: Minimum 60 mils nominal.
b. Exposed Face Color: "Gray"

B. Approved Products/Manufacturers (Roofing):

1. Subject to compliance with requirements, provide the "Basis of Design" product or an equivalent product of one of the following:

a. Elevate
b. GAF Materials Corp.
c. Johns Manville

2. Membrane manufacturer must certify in writing that product supplied for this project has a minimum polymer thickness as specified. ASTM ± tolerance for membrane thickness is not acceptable.

C. Approved Products/Manufacturers (Insulation):

1. Subject to compliance with requirements, provide products approved by the "Basis of Design" roofing manufacturer or an equivalent product of one of the following:

a. Atlas Roofing Corporation.
b. Carlisle SynTec Incorporated.
c. Elevate (formerly Firestone Building Products).
d. GAF
e. Hunter Panels.
f. Johns Manville.

2.02 TPO MEMBRANE MATERIALS

A. Membrane: Flexible, heat weldable sheet composed of thermoplastic polyolefin polymer and ethylene propylene rubber; complying with ASTM D 6878, with polyester weft inserted reinforcement and the following additional characteristics for use over all substrates, for fully adhered installation.

1. Thickness: 0.060 inch plus/minus 10 percent, with coating thickness over reinforcement of 0.024 inch (0.61 mm) plus/minus 10 percent.
2. Sheet Width: Provide the widest available sheets to minimize field seaming.
3. Puncture Resistance: 265 lbf (1174 N), minimum, when tested in accordance FTM 101C Method 2031.
4. Solar Reflectance: 0.79, minimum, when tested in accordance with ASTM C 1549.
5. Color: Gray.

B. Formable Flashing: Non-reinforced, flexible, heat weldable sheet, composed of thermoplastic polyolefin polymer and ethylene propylene rubber.

1. Thickness: 0.060 inch (1.52 mm) plus/minus 10 percent.

2. Tensile Strength: 1550 psi (10.7 MPa), minimum, when tested in accordance with ASTM D 638 after heat aging.
3. Elongation at Break: 650 percent, minimum, when tested in accordance with ASTM D 638 after heat aging.
4. Tearing Strength: 12 lbf (53 N), minimum, when tested in accordance with ASTM D 1004 after heat aging.
5. Color: Gray.

C. Provide roofing materials recognized to be of the generic type indicated and tested to show compliance with indicated performances.

D. Provide products which are recommended by the manufacturer to be fully compatible with the individual substrates, or provide separation materials to eliminate contact between incompatible materials.

2.03 COVER BOARD (GLASS MAT)

A. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Georgia-Pacific Corporation; DensDeck Prime
   b. USG Corporation; Securock Glass Mat Roof Board.
   c. CertainTeed Corporation; GlasRoc Sheathing.
   d. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.

2. Thickness: 1/2 inch.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck.

2.04 COVER BOARD (HIGH DENSITY POLYISO)

A. Cover Board: High-density insulating cover board complying with ASTM C 1289 Type II, Class 4, Grade 1 (109 psi maximum), of type and thickness indicated below:

1. Thickness: 1/2 inch.
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Carlisle; SecurShield HD Plus Polyiso
   b. Equivilent product of the other named manufacturers

3. Board Size: 48 x 96 inches
4. Board Edges: Square
5. Compressive Strength: ASTM D 1621, 109 pounds per square inch.
6. Dimensional Stability: ASTM D 2126, <0.5% linear change)
7. Water Absorption: ASTM C 209, Less than 1 volume
8. R-value: ASTM C518: 2.5/inch
9. Weight: 0.406 lbs./sq.ft.

2.05 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated

1. Insulation boards shall be free of the following ozone-depleting blowing agents: hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs), and chlorofluorocarbons (CFCs).
2. Provide insulation products as manufactured by, or labeled by the manufacturer of primary roofing components as appropriate and compatible with the system for the intended application. Roof insulation must be included under primary roofing manufacturer's warranty as specified.
3. Provide insulation materials that are identical to materials whose fire-performance approval and wind up-lift classification have been determined for the assemblies of which the insulation materials are a part.
4. Roofing systems must be applied over cover board as indicated, below. In no case shall roofing systems be applied directly over polyisocyanurate foam insulation.
5. Provide insulation in manufacturer’s standard sizes for each application indicated.

6. Provide insulation materials and insulation fastening in accordance with the primary membrane material manufacture's latest printed instructions and recommendations and is accordance with FM Approval Standards.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 2, Grade 2, rigid board insulation with coated glass facing on both sides.

1. Compressive Strength: 20 psi per ASTM D1621
2. Dimensional Stability: ASTM D2126; 2% linear change(7 day)
3. Moisture Vapor Transmission: ASTM E96;< 1 perm
4. Thermal Resistance: R-value of 5.7 per inch, LTTR minimum
5. Board Size: 4 foot x 4 foot or 4 foot x 8 foot
6. Minimum board thickness: 3 inches (each layer)
7. Board Edges: Square
8. Manufacturers: As approved by roof membrane manufacturer:

    a. Specified roof membrane manufacturer named in Article 2.01 "Manufacturers"

9. Application: Adhered to existing concrete roof decks.

C. Tapered Insulation: Provide tapered insulation board of same material as board insulation specified in paragraph above; tapered to slope indicated on the drawings; manufacturer's standard dimensions. Insulation system design and layout drawing provided shall indicate a minimum of two (2) layers to allow for staggering of insulation joints in both directions.

1. Board Size: 4 foot x 4 foot

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated to properly direction water flow to the nearest drain. Fabricate to slopes indicated.

2.06 ROOFING ACCESSORIES

A. Wood plates, nailers, curbs, blocking, stripping, pipe supports, and similar members in connection with roofing and flashing: Conform to the requirements of Section 06 10 53 – Miscellaneous Rough Carpentry.

B. Molded Flashing Accessories: Unreinforced TPO membrane pre-molded to suit a variety of flashing details, including pipe boots, inside corners, outside corners, etc.

C. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars with rounded edges, capable of securing the single ply roofing membrane material without cutting or otherwise damaging the membrane material, approximately 1 by 1/8 inch thick; with stainless steel screw fasteners with expansion shield and reverse bend for sealant application along the top edge.

D. Pipe Seal: Pre-molded boot with pressure-sensitive seal and stainless steel draw-band clamp shall be approved and supplied by the membrane supplier.

E. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, sealants and other accessories.

F. Liquid-Applied Flashing**:** Two-component polymethyl methacrylate-based (PMMA) liquid flashing material for transitions between TPO roofing membrane and sheet metal penetrations through roof.

G. Pitch Pans:

1. Dimensions: 3 inch flanges with adjustable width from 4 inches to 7 inches, and adjustable height from 2 inches to 4 inches.
2. Material: Stainless Steel.
3. Pitch Pan Filler: Manufacturers two-component flexible pourable sealer applied over 2 inch base of cured non-shrink grout.

2.07 VAPOR RETARDER SHEET

A. Rubberized Asphalt Composite: Vapor Retarder/Temporary Roof membrane as follows:

1. Sheet Membrane 40-mil composite consisting of 35 mils of self-adhering rubberized asphalt laminated to a 5-mil woven polypropylene film.
2. Basis of Design: Carlisle VapAir Seal 725TR

3. Acceptable Manufacturer/Product:

   a. Equivalent product of other named roofing manufacturers.

B. Application: Self-adhere membrane to concrete deck.

2.08 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

D. Tapered Edge Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board, if applicable.

2.09 ROOFING ACCESSORIES

A. Wood plates, nailers, curbs, blocking, stripping, pipe supports, and similar members in connection with roofing and flashing: Conform to the requirements of Section 06 10 53 – Miscellaneous Rough Carpentry.

B. Molded Flashing Accessories: Unreinforced TPO membrane pre-molded to suit a variety of flashing details, including pipe boots, inside corners, outside corners, etc.

C. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars with rounded edges, capable of securing the single ply roofing membrane material without cutting or otherwise damaging the membrane material, approximately 1 by 1/8 inch thick; with stainless steel screw fasteners with expansion shield and reverse bend for sealant application along the top edge.

D. Pipe Seal: Pre-molded boot with pressure-sensitive seal and stainless steel draw-band clamp shall be approved and supplied by the membrane supplier.

E. Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads sourced from membrane roofing system manufacturer.

F. Expansion Joint Supports: Provide factory fabricated extruded EPDM Sponge, compatible with TPO membrane and flashings.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, sealants and other accessories.

H. Liquid-Applied Flashing**:** Two-component polymethyl methacrylate-based (PMMA) liquid flashing material for transitions between TPO roofing membrane and sheet metal penetrations through roof.

I. Pitch Pans:

1. Dimensions: 3 inch flanges with adjustable width from 4 inches to 7 inches, and adjustable height from 2 inches to 4 inches.
2. Material: Stainless Steel.
3. Pitch Pan Filler: Manufacturers two-component flexible pourable sealer applied over 2 inch base of cured non-shrink grout.

PART 3 – EXECUTION

3.01 INSPECTION

A. Installer of elastomeric roofing system must examine substrate and conditions under which roofing work is to be performed and must notify Contractor, in writing, of unsatisfactory conditions. Do not proceed with roofing work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

1. Verify deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to roof drainage.
2. Do not apply roofing materials to damp, frozen, dirty, dusty, or deck surfaces unacceptable to manufacturer.
3. Verify deck surfaces are dry and free of snow or ice.
4. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations.
5. Beginning installation means acceptance of existing substrate.

3.02 PREPARATION OF SUBSTRATE

A. General: Comply with manufacturer's instructions for preparation of substrate to receive the roofing system and with provisions of Section 07 01 50.

B. Install new nailers per Section 06 10 53 for securement of metal flashings and roof specialties. Nailers shall be installed as indicated on project drawings and in accordance with Section 06 10 53 requirements.

C. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections. Wipe metal deck surface clean using acetone.

D. Provide temporary closures to assure that moisture does not damage any completed section of the new roofing system. Completion off flashings, terminations and temporary closures must be completed a work progresses to provide a watertight condition.

E. Install cant strips, flashings, and accessory items as shown and if required by manufacturer even though not shown.

F. Verify that wood blocking, curbs and nailers are securely anchored and that roof openings and penetrations are in place and set and braced.

G. Air/Vapor Retarder Sheet: Loosely lay sheet in a single layer over entire areas of roof with side and end laps of sheet overlapped 2-inch and 6-inch, respectively using manufacturer’s approved adhesive. Completely seal air/vapor retarder at terminations, obstructions and penetrations. Coordinate sealing perimeter edges of air/vapor retarder with vertical transitions at perimeter wall to ensure continuity from roof to wall envelope.

3.03 ROOF PROTECTION

A. Protect existing roof membrane and rooftop appurtenances from damage during construction operations. Provide plank or plywood protection for wheeled or other traffic over existing building roof surfaces. Protect existing roof membrane and rooftop appurtenances from damage during construction operations. Temporary protection shall be erected/installed at all interior and exterior locations as required to prevent damage to existing surfaces.

B. After completing roofing (including associated work), institute appropriate procedures for surveillance and protection of roofing during remainder of construction period. At the end of the construction period, or at a time when the remaining construction will in no way affect or endanger roofing, make a final inspection or roofing and prepare a written report to Owner, describing nature and extent of deterioration or damage found.

C. Repair or replace (as required) deteriorated or defective work found at the time of final inspection to a condition free of damage and deterioration at the time of Substantial Completion and according to the requirements of the specified warranty.

3.04 INSULATION APPLICATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.

C. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

D. Install two or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 5 inches or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

E. Install first layer of roof insulation with long dimension running perpendicular to the roof slope; long joints shall be laid in a continuous straight line with end joints staggered by half a board length. Butt all boards as closely as possible. Coordinate installation of insulation for curbs with thickness of counterflashing as required in Section 07 62 00 – Sheet Metal Flashing.

1. Install second layer of roof insulation in the same manner as specified for first layer; install with joints staggered from joints in first layer a minimum of 6 inches in each direction.
2. Cut insulation at vertical intersections to allow a clearance of not more than 1/4 inch.
3. Trim and fit insulation accurately at all deck protrusions and terminations as required for a smooth transition with no breaks or sharp edges. Miter insulation boards at ridges and elsewhere to prevent open joints or irregular surfaces.
4. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
    a. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
    b. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof. Fasten insulation according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification and to resist uplift pressure at corners, perimeter, and field of roof in accordance with performance and warranty requirements.
5. Where indicated or required, install tapered insulation to achieve positive drainage (no ponding water) and to maintain a minimum slope of 1/4 inch per foot; install tapered insulation with fasteners or adhesive as recommended by membrane manufacturer. If required due to the minimum thickness of tapered insulation, install tapered edge strips of high density wood fiber board to provide a smooth transition to the flat areas.
6. At drains, install tapered insulation directly over thermal barrier; tapered insulation shall be carried back from drains a minimum of 24 inches; bevel insulation flush with drain body. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
7. Exercise care when handling and attaching insulation so as to not damage or rupture the facer and surface.
8. Do not install more insulation board that can be covered with sheet membrane by the end of the day or the onset of inclement weather.
9. Install single layer of protection board over insulation in the same manner as specified for thermal insulation, with both the long and short joints offset from the joints in the thermal insulation. Fasten in accordance with approved wind up-lift fastening requirements.

F. Install crickets in areas of roofing at rooftop appurtenances larger than 2’-0” x 2’-0” in size, to provide positive sloping away from rooftop units and to roof drains.

G. Provide sumps around all roof drains using tapered insulation. Sumps shall be 8’-0” x 8’-0” in size. Insulation shall have a constant, gradual slope from the perimeter of the sump to the drain bowl. Severely sloped sumps will be rejected.

H. Complete installation of roof drain assembly on a daily basis. Temporary installation at drain bowl assemble shall not be allowed. Clamping rings and sealant shall be applied to assure a water tight installation at the end of each work day.

I. Cover Boards: Install cover board over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below cover board a minimum of 6 inches in each direction. Loosely butt cover boards together.

1. Fasten insulation according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification and to resist uplift pressure at corners, perimeter, and field of roof. in accordance with performance and warranty requirements.

3.05 ADHERED MEMBRANE ROOFING INSTALLATION

A. Start installation only in presence of manufacturer's technical representative. Manufacturer's technical representative shall also periodically inspect progress and quality of work.

B. Install TPO sheet over area to receive roofing according to roofing system manufacturer's written application instructions. Nothing specified herein shall supersede roofing system installation in accordance with manufacturer's approved installation procedures. Unroll sheet and allow to relax for time period required by manufacturer. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. Cut sheets to maximum size possible, in order to accommodate contours of roof deck and proper drainage across shingled laps of sheets.

D. Fully Adhered Membrane Roofing:

1. The fiberglass reinforced roof membrane shall be adhered to the coverboard with adhesive supplied by the membrane manufacturer.
2. Apply bonding adhesive to substrate and underside of sheet as required by manufacturer. Do not apply adhesive with seam welding area.
3. Install mechanical fasteners, flashings and counter flashings, as required for this specific project, and use accessories at locations and as recommended by manufacturer.

E. Flashings are surface mounted against walls or roof mounted equipment with counterflashings. Anchor flashings with manufacturer's continuous metal termination bars.

F. Install roofing manufacturer's control joint materials to isolate roof into areas as shown. Seal roofing membrane sheet to joint flange; apply sealant to edge or seam.

G. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

H. Sealing of seams of overlapping adjacent roof membrane sheets, or overlap seams between flashing components and roof membrane sheets, must be accomplished using hot air equipment specified by the membrane manufacturer for the specific membrane type, in strict compliance with roof membrane manufacturer's requirements and specifications.

1. Splice all side and end laps of the sheet membrane and flashing, add all connection to TPO coated metal.
2. Hot air weld splices with automatic air welders. Hand held welders my only be used for small localized areas and for areas that are inaccessible to automatic welders.

    a. Splice all side and end laps of the sheet membrane and flashing, add all connection to TPO coated metal.
    b. Hot air weld splices with automatic air welders. Hand held welders my only be used for small localized areas and for areas that are inaccessible to automatic welders.

I. Install flashings and counter flashings, and accessories at locations and as recommended by manufacturer.

J. Apply daily seal for temporary sealing of membrane edge to existing roofing at end of each day's work to prevent water infiltration to roofing substrate.

K. Pitch Pockets:

1. Fabricate and install new pitch pockets from galvanized steel in accordance with NRCA and roofing manufacturers recommendations.
2. Fill the pocket halfway to the top with non-shrink grout and the remainder with pourable sealer.
3. Slope fill away from the penetration to the edge of the pocket.
4. Install metal rain collars with drawbands that cover and overlap the entire pocket and caulk the top of the drawband with sealant.
5. Strip in the metal flanges of the pitch pocket per the sequence described above for stripping plies.

3.06 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

1. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
2. Flash penetrations and field-formed inside and outside corners with sheet flashing.

3. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
4. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

B. Base Flashing at Curbs:

1. Install base flashing as indicated and required by manufacturer. Use longest pieces practicable.
2. Install base flashing up vertical surfaces minimum 8 inches above cant top or edge strip unless otherwise noted. Fasten top of base flashing with devices and at locations and frequency as recommended by manufacturer.
3. Coordinate installation of base flashing with Flashing and Sheet Metal.
4. Extend splice beyond fasteners which attach flashing to roof membrane a distance as required by manufacturer.
5. Bond base flashing to substrate in accordance with manufacturer’s requirements to obtain water tight bond.
6. Take measures to ensure base flashing is not ridging where there is change of direction.
7. Fasten top of base flashing under metal counterflashing at manufacturer's recommended spacing.
8. Flash penetrations passing through membrane

C. Install counterflashing at wall and curb flashing.

D. Install drawband collars at all penetrations.

3.07 ROOF DRAINS

A. Fully adhere base ply to drain and turn down 1 inch inside drain.

B. Fully adhere cap ply over previous layers.

C. Cut out opening, install clamp ring and strainer. Seal clamp bolts.

D. Drain Flashings:

1. Roof drain flashing shall be fully adhered, without seams located in drain sump, and installed in strict accordance with the membrane manufacturer's requirement and the enclosed drawings.
2. During the flashing operation, drain openings shall be protected against debris, etc. Prior to roofing activities, inspect the drainage system to ensure proper drainage. Any defects in drainage shall be corrected immediately. During construction, install drain plugs. Plugs must be removed at the end of each workday or during work stoppage.
3. Drain sumps shall be tapered to the drain. In cases where a tapered insulation system is utilized, incorporate drain and drain flashing into tapered design, to ensure continuity of water flow.
4. Check whether the drain bowl and the drain pipe are attached solidly without cause for leakage.
5. Clamp rings/bolts where distorted, damaged, or corroded, shall be replaced. Where appropriate cut new threads to secure clampring.
6. Drain flashing shall be set in a bed of water cut-off mastic. Water cut-off mastic shall be placed in quantities to prevent overflow into drain.
7. Upon completion of roofing activities, check drain pipe, to ensure that drain line is free of obstructions.

3.08 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated or, if not indicated, from roof access indicated to and around roof-mounted mechanical equipment. Adhere walkway products to substrate according to roofing system manufacturer's written instructions. Space walkway pads one-inch apart to permit drainage. Discontinue walkways over all field splices to provide a minimum one-inch gap over the seam edge.

3.09 WELDING PROCEDURES

A. General: Clean seam areas, overlap sheets, and weld side and end laps of sheets and flashings according to manufacturer’s written instructions to ensure a watertight seam installation. Seam overlaps shall be a minimum of 3 to 4 inches wide, as approved by manufacturer.

1. Welding equipment shall be of type as approved by sheet membrane manufacturer.

2. Seams must be clean and dry; no adhesives shall be used within the seam area.

B. Welding of Seams: All seams shall be hot air welded as standard with sheet membrane manufacturer. Insert the hot air nozzle and draw at a uniform rate between the overlapping sheets. Apply positive pressure immediately to the top sheet. Fusion of the two mating surfaces shall occur immediately following the heating process.

C. Welding of TPO Clad Metals: As recommended by membrane manufacturer.

D. Testing of Seams:

1. Installer shall test the outside edge of the seam with a round pointed metal probe along the edge of the welded lap area. The completed lap shall be free of any voids, fishmouths, or wrinkles, and shall lay flat.
2. Refer to article “Field Quality Control” for field testing of seams in presence of Inspector.

E. Repair tears, voids, and lapped seams in roofing that does not meet manufacturer’s requirements.

3.10 FIELD QUALITY CONTROL

A. Observation of Installation by Owner Personnel: Representatives from Facility Operations Roofing and Envelope Engineering shall be notified of roofing schedule and perform periodic installation inspections.

B. The Owner reserves the right to cut test panels from the finished roof in order to determine that the minimum requirements have been met. The roofer shall repair, at his own expense, the roof where test panels were taken.

C. Manufacturer’s Representative: Manufacturer’s Field Technical Representative shall inspect construction activities, at start of work and minimum two (2) times during roofing installation, including final inspection:

1. Submit a written report after each inspection noting as a minimum weather conditions, condition of stored materials, work in progress, condition of substrates, number of workers and which workers have completed manufacturers’ training programs, and all other pertinent data.
2. Services of manufacturer’s field representative are not intended to supersede manufacturer’s written requirements for inspection and testing to issue warranty.

D. On-site evaluation of welded seams shall be made daily by the Contractor to assure membrane seam weld quality.

1. Test cuts shall be taken at each start-up of welding equipment, mid-point, and at each completion of the welding process. Correct welds displaying failure from equipment settings as necessary to assure quality welds. Based on test cut findings, appropriate membrane seam remedies must be instituted. Membrane test cut locations shall be documented and membrane test cut samples shall be labeled and provided with the required Daily Construction Reports. Additional test cuts of suspect membrane seams shall be taken at the direction of the Architect’s Representative or manufacturer’s representative. Each test cut shall be patched by the Contractor at no extra cost to the Owner.

E. Final Inspection:

1. At completion of roofing installation and associated work, meet with Contractor, installer, installer of associated work, Owner, roofing system manufacturer’s representative, and other representatives directly concerned with performance of roofing system.
2. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.
3. The roofing system manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the Contractor.
4. If core cuts verify the presence of damp or wet materials, the Contractor shall be required to replace the damaged areas at his own expense.
5. Repair or replace deteriorated or defective work found at time above inspection as required to a produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
6. Notify the Owner upon completion of corrections.

7. Following the final inspection, provide written notice of acceptance of the installation from the roofing system manufacturer.

F. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

D. Debris shall not accumulate on roof during construction. All debris shall be totally removed at completion of project. The contractor shall provide final cleaning of roof membrane to sufficiently remove traffic marks and unsightly blemishes from the surface of the roof to the satisfaction of the A/E and Owner. The contractor shall provide adequate protection to the new roof surface to prevent excessive traffic marks and unsightly blemishes during the course of construction.

3.12 INSPECTION AND WARRANTY

A. Upon completion of the installation, an inspection shall be made by a representative of the roofing manufacturer to ascertain that the roofing system has been installed according to the manufacturer's published specifications and details.

B. Warranty to be issued upon approval of the installation.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes providing sheet metal for the following applications:

1. Formed flashing.
2. Formed low-slope roof flashing.
3. Formed brake-metal work.
4. Flashings used in conjunction with roofing system sheet membrane base flashings.
5. Sealant in conjunction with sheet metal work specified herein.

B. Related Sections:

1. Section 06 10 00 – Rough Carpentry for wood nailers, curbs, and blocking; flexible flashing at openings.
2. Section 07 42 13: Formed Metal Wall Panels: Flashings part of metal panel system and panel components.
3. Division 07 Roofing Sections: Sheet metal flashing integral with roofing membrane.
4. Section 07 92 00 – Joint Sealants for field-applied sheet metal flashing sealants.

1.02 REFERENCES

A. National Roofing Contractors Association (NRCA): The NRCA Roofing and Waterproofing Manual.

B. Sheet Metal and Air Conditioning National Association (SMACNA):

1. Architectural Sheet Metal Manual

1.03 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Completed sheet metal flashing shall not rattle, leak, or loosen, and shall remain watertight.
2. Design system capable of withstanding building code requirements for negative wind pressure.
3. Shop or field formed roof membrane termination are not acceptable.

B. Sheet Metal Standard for Flashing: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for SMACNA – Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. SPRI Wind Design Standard: Manufacture and install roof edge specialties tested according to ANSI/SPRI ES-1 and conforming to the following:

1. ANSI/SPRI/FM 4435/ES-1 – Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.
2. Design Pressure: As indicated on Drawings.
3. Design Requirements: Manufacturer is responsible for designing units, including anchorage to structural system and necessary modifications to meet specified requirements.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

F. Installation Requirements: Fabricator is responsible for installing system, including anchorage to substrate to maintain visual design concepts in accordance with Contract Documents and following installation methods as stipulated in the SMACNA.

1. Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, and profiles of units.
2. Make modifications only to meet field conditions and to ensure fitting of system components.
3. Provide concealed fastening wherever possible.
4. Attachment considerations: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between units and building structure or between components themselves.
5. Obtain Architect's approval for connections to building elements at locations other than indicated in Drawings.
6. Accommodate building structure deflections in system connections to structure.

1.04 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

C. Shop drawings:

1. Fully dimensioned large scale design details showing material profiles, splices, flashing terminations and other jointing details, fastening methods and installation details. Indicate material type, sizes, and weights or gages. Indicate extent of adjacent work specified under other Sections of the Specifications.
2. Fully detail methods of relieving stresses due to thermal movement, including sealing of expansion seams.
3. All details bearing dimensions of actual measurements taken at the project.

D. Selection Samples:

1. Metal sample chips, indicating Manufacturer's full range of finish colors for factory finishes available for selection by Architect.
2. Manufacturer's sample boards for sealant colors.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested and FM Approvals approved.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Sample Warranty: For special warranty.

E. Closeout Submittals:

1. Manufacturer’s warranties: Include coverage of materials and installation and resultant damage from failure of installation to resist penetration of moisture.

1.06 QUALITY ASSURANCE

A. Sheet Metal Flashing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1. Meet with the Owner, Architect and Owner’s insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing.

3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.07 QUALIFICATIONS

A. Fabricator and Installer:

1. Company specializing in work of this Section with minimum 5 years documented experience installing commercial quality work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing materials in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering from exposure to sunlight and high humidity, except to extent necessary for period of installation.

1.09 COORDINATION

A. Coordinate installation of sheet metal flashing with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Pre-Finished Sheet and Sheet Coil Coating Warranties: Manufacturer’s 20 year warranty, for each sheet material, against fading, color change, chalking, peeling, cracking, or delaminating.

PART 2 – PRODUCTS

2.01 EXPOSED SHEET MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface, minimum 26 gauge (0.018 inch), except as otherwise indicated.

1. Finish: 2D (dull, cold rolled).

2.02 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

2.03 ACCESSORY MATERIALS

A. Accessories: Provide accessory components required for a complete finished installation.

B. Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and accessory items for a complete system and as recommended by sheet metal manufacturer and fabricator for metal work, unless otherwise indicated.

C. For preservative-treated and fire retardant-treated lumber, and High Humidity Area fasteners shall be stainless-steel connectors and fasteners (Type 304 or 316 stainless steel), copper or silicone bronze fasteners.

1. Mechanically galvanized fasteners and connectors are prohibited.
2. Fastener metal type for flashings shall match the flashing metal type.
3. Expansion type fasteners are prohibited for use in stone and brick.
4. Fasteners in masonry shall be installed in the mortar joints, or where required to be in the masonry unit, shall be drilled and set in epoxy.

D. Fasteners: Provide same metal as sheet metal or other non-corrosive compatible metal recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

E. Metal Accessories: Provide cleats, straps, anchoring devices, and similar accessory units for installation of work, noncorrosive, size and gauge required for performance.

2.04 FABRICATION

A. General: Custom fabricate sheet metal flashing to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing in shop to greatest extent possible.

1. Fabricate sheet metal flashing in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabricate non-moving seams in sheet metal with flat lock or butt hairline joints except as otherwise indicated. Fabricate corners mitered, soldered and sealed as one piece. Locate corner joints 2'-0" from corners and intersections. Where soldered flat-lock seams are not possible, use soldered riveted lap seams joints for additional strength.

C. Fabricate cleats and starter strips of same material as sheet, interlockable with sheet. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

D. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

1. Use stainless-steel fasteners.

E. Seams:

1. Provide following seam types unless noted or detailed otherwise.

a. Flat: Flat lock.
b. Corner: Double lock corner
c. Standing: Double lock standing lap seam.

F. Flashing and Counter Flashing:

1. Fabricate as indicated on Drawings.
2. Hem exposed flashings on underside ½-inch (13-mm); miter and seam corners.
3. Fabricate vertical faces with bottom edge formed outward ¼-inch (6-mm) and hemmed to form drip.
4. Fabricate flashings to allow toe to extend minimum 2-inches (50-mm) over wall surfaces.

G. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

H. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

I. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1-inch (25-mm) deep, filled with mastic sealant (concealed within joints).

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FLASHING INSTALLATION – GENERAL

A. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with the SMACNA – Architectural Sheet Metal Manual. Anchor units of work securely in place by methods indicated, providing for thermal expansion of units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.

1. Install units plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction.
2. Apply asphalt mastic on stainless steel surfaces of units in contact with dissimilar metals.
3. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
4. Miter, lap seam and close corner joints with solder. Seal seams and joints watertight.
5. Install expansion joints at frequency recommended by SMACNA. Do not fasten moving seams such that movement is restricted.
6. Coordinate with installation of roofing system and roof accessories.

B. Provide for separation of metal from non-compatible metal or corrosive substrate by coating concealed surfaces at contact location with bituminous coating or other permanent separation as recommended by the sheet metal manufacturer.

C. Where metal flashing is installed over wood-preservative-treated lumber, install continuous waterproof or felt underlayment as a separator between wood and flashing.

D. Counterflashing and Reglets:

1. Fabricate counterflashings and reglets as 2 piece assemblies to permit installation of counterflashing after base flashings are in place.
2. Fabricate reglets of same metal and thickness as counterflashings.
3. Overlap roof base flashing 4 inches (100 mm) minimum.
4. Install bottom edge tight against base flashing.
5. Lap seam vertical joints 3 inches (75 mm) minimum and apply sealant.

E. Install starter and edge strips, and cleats before starting installation. Insert flashings into reglets to form tight fit. Seal flashings into reglets with sealant. Anchor units securely in place by methods indicated, providing for thermal expansion. Conceal fasteners and expansion provisions unless otherwise approved by the Architect. Install joint sealants where indicated.

F. Seal movable non-expansion type joints with joint sealant. Form joints as indicated, when not indicated, in compliance with industry standards to receive joint sealants.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 – Joint Sealants.

G. Install sheet metal flashing true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.

H. Expansion Provisions: Provide for thermal expansion of exposed flashing. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

3.03 INSTALLATION HEADER FLASHING

A. Install specified flashing at window heads, piping, vents and all other projections from vertical surfaces where rain water may accumulate. Flashing shall be of continuous length for full width of window head, joints in flashing is not acceptable. Flashing shall extend behind air infiltration barrier a minimum of 3 inches up the wall.

3.04 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.

1. Secure in a waterproof manner by means of snap-in installation and sealant.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for flashing on vent piping.

3.05 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Remove temporary protective coverings and strippable films as sheet metal flashing are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

C. Replace sheet metal flashing that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 71 00

ROOF SPECIALTIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes manufacturer fabricated roof edge fabrications. Work includes, but is not limited to the following types:

1. Copings
2. Counterflashings and reglets
3. Gutters and downspouts
4. Underlayment
5. Accessories

B. Related sections:

1. Section 06 10 00 – Rough Carpentry for wood nailers, curbs, and blocking.
2. Section 07 54 00 – Thermoplastic Membrane Roofing
3. Section 07 62 00 – Sheet Metal Flashing: Custom- and site-fabricated sheet metal flashing and trim.
4. Section 07 92 00 – Joint Sealants for field-applied sealants.

1.02 DEFINITIONS

A. Prefabricated or Manufactured Roof Specialties: Items that will be plant manufactured ready for installation on a roof or parapet. Edge securement for low-slope roofs shall demonstrate compliance with ANSI/SPRI ES-1.

1.03 REFERENCES

A. ASTM International:

1. ASTM A 240/A 240M – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2020a.
2. ASTM B 32 – Standard Specification for Solder Metal; 2020.
3. ASTM C 920 – Standard Specification for Elastomeric Joint Sealants; 2018.

B. SMACNA – Architectural Sheet Metal Manual of the Sheet Metal and Air Conditioning Contractors National Association, Inc., 2012

1.04 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. SPRI Wind Design Standard: Manufacture and install roof specialties tested according to ANSI/SPRI ES-1 and conforming to the following:

1. ANSI/SPRI/FM 4435/ES-1 – Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.
2. Design Requirements: Manufacturer is responsible for designing units, including anchorage to structural system and necessary modifications to meet specified requirements.

C. Thermal Movements: Provide manufactured roof specialties that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Water Infiltration: Provide manufactured roof specialties that do not allow water infiltration to building interior.

E. Roof Specialties: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

1.05 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Show layouts of manufactured roof specialties, including plans and elevations.

1. Identify manufacturer fabricated versus field-assembled work. Include the following:

a. Details for fastening, joining, supporting, and anchoring manufactured roof specialties including fasteners, clips, cleats, and attachments to adjoining work.
b. Details for expansion and contraction.
c. Details of termination points and assemblies, including fixed points.
d. Details of special conditions, including accessory locations.

C. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

D. Samples for Verification:

1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.

1.06 INFORMATIONAL SUBMITTALS

A. Quality Assurance/Control Submittals:

1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include preparation instructions and recommendations, storage and handling requirements and recommendations and installation methods.
2. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, verifying compliance of roof edge flashings with performance requirements.

B. Closeout Submittals:

1. Warranty: Special warranty specified in this Section.
2. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Comply with applicable recommendations and details of the "Architectural Sheet Metal Manual" of the Sheet Metal and Air Conditioning Contractors National Association, Inc., and the National Roofing Contractors Association.

B. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are SPRI ES-1 tested to specified design pressure.

C. Source Limitations: Obtain roof specialties approved by manufacturer providing roof-system warranty specified in Division 07.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

D. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

1.09 COORDINATION

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication indicate measurements on Shop Drawings.

B. Coordinate installation of manufactured roof specialties with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1. Verify that other trades and related work are complete before mounting roof specialties.

a. Ensure that information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
b. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

2. Mounting surfaces shall be straight and secure; substrates shall be of proper width.
3. Refer to the construction documents, shop drawings and manufacturer’s installation instructions.
4. Coordinate installation with roof membrane manufacturer’s installation instructions before starting.

1.10 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

B. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.

2.02 EXPOSED SHEET METALS USED WITH COUNTERFLASHINGS, ROOF EDGE FLASHINGS ASSOCIATED WITH ROOFING

A. Aluminum Sheet: ASTM B 209, Alloy 3003, 3004, 3105, or 5005 as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

1. Surface: Smooth, flat finish.
2. Exposed Coil-Coated Finishes: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 620. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
b. Concealed Surface: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished indicated.

1. Exposed High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

2.03 CONCEALED METALS

A. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304.

2.04 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners: Series 300 stainless steel, unless otherwise noted.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

D. Elastomeric Sealant where indicated only; ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

1. Provide where sealant will be exposed or movement exceeds butyl sealant movement capacity.

E. Butyl Sealant unless otherwise noted: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

F. Bituminous Coating: Cold-applied asphalt mastic, ASTM D 1187 or SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.05 ROOF EDGE FLASHINGS

A. Roof-Edge: Manufactured, one-piece and two-piece, roof-edge consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous galvanized steel anchor bar with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane.

1. Roof Edge Fascia Material: Formed Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for type of use and structural performance indicated, nominal 0.063 inch thick thickness as required to meet performance requirements.

    a. Surface: Smooth, flat finish.
    b. Finish: Two-coat fluoropolymer.
    c. Color: As selected by Architect from manufacturer's full range.

2. Waterdam: Continuous 24 gauge commercial type G-90 galvanized steel at 12’-0” standard lengths.
3. Corners: Matching corner units; factory mitered and continuously welded.
4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
5. Accessories: End wall flashing, concealed splice plates, 8-inch minimum wide, finished to match finish of flashing with factory applied butyl sealant strips.
6. Provide endwall flashing splice plates where roof edge terminates into wall.

2.06 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, provide one of the following:

1. Cheney Flashing Company.
2. Fry Reglet Corporation.
3. OMG Roofing Products.
4. Keystone Flashing Company.
5. Metal-Era, Inc.
6. Heckmann Building Products Inc.

B. Counterflashings: Manufactured units in lengths not exceeding 12 feet designed to snap into reglets and compress against base flashings or roof membrane with joints lapped, from the following exposed metal in thickness indicated:

1. Aluminum: 0.032 inch thick
2. Stainless Steel: 0.0187 inch thick (fka 26 gauge)
3. Prepainted, Metallic-Coated Steel: 0.028 inch thick (fka 24 gauge)

C. Reglets/Receivers: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashings indicated with factory-mitered and - welded corners or mechanically clinched and sealed watertight, and junctions, from the following exposed metal in thickness indicated:

1. Stainless Steel: 0.0187 inch thick
2. Prepainted, Metallic-Coated Steel: 0.028 inch thick (fka 24 gauge)
3. Corners: Factory mitered and continuously welded or mechanically clinched and seal watertight.
4. Types:

    a. Surface-mounted with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
    b. For masonry application, refer to Section 04 22 00 – Concrete Unit Masonry.

D. Accessories:

1. Counterflashing wind-restraint clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing louver edge.
2. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.

2.07 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 120-inch- long sections. Furnish flat-stock gutter spacer/bracket and hanger rods fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.

1. Profile:

    a. Half-round profile similar to SMACNA Fig. 1-3A.
    b. Drops: Fabricated to seal at gutter penetration and nest inside downspout, similar to SMACNA Fig. 1-24C, round.

2. Mounting Style:

    a. Half-round profile, prefabricated strap hanger: SMACNA Fig. 1-20A.

        1) Finish: Finish to match gutter

3. Material: Provide minimum gauge for gutter size and material as listed in SMACNA Table 1-5 unless noted otherwise

    a. Material: 24 gauge galvanized reverse bead half-round gutter.
    b. Finish: Unpainted

4. Expansion Joints: Lap type, similar to SMACNA Figs. 1-5, 1-6 and 1-7.

    a. Lap joints in direction of water flow.
    b. Spacing: 50’-0” o.c., maximum.

5. Spacers and Brackets: Flat-stock spacers and brackets fabricated from same metal as gutters, wrapped in metal; to match gutter, of size recommended by SMACNA but not less than twice the gutter thickness. Spacing: 3'-0" o.c.
    a. Brackets:
        1) Galvanized: 0.1875” x 1”.
    b. Spacers: 1/16” x 1”, space alternately with brackets.
    c. Elbows, offsets and End Caps: Galvanized
6. Gutter Bead Reinforcing Bars: 1/8” flat stock material to match gutter.
7. Strainer: Galvanized steel, similar to SMACNA Fig. 1-24D, round.
        1) Wire ball downspout strainer.

B. Downspouts: Fabricate downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Profile: Sizes as indicated on the Drawings.
    a. Round: Similar to SMACNA Fig. 1-31B (3)
2. Materials: .24 gauge galvanized.
3. Fabricated Hanger Style:
    a. Round: Similar to SMACNA Fig. 1-35E.
    b. Spacing: 8’-0” intervals vertically

C. Downspout brackets: Fabricate from 1/16” by 1” galvanized steel. Finish to match downspout.

1. Fabricate from: Galvanized 0.050 inch thick.
2. No post painting of gutter support brackets

D. Drip Edge: Fabricate edge items to profiles indicated. Fabricate to a minimum 96” long sections. Furnish cleat attachment and other required accessories at same metal.

1. Fabricate from: Galvanized 0.050 inch thick.
2. Fasteners: Stainless steel.

E. Plumbing Vent Flashings: Galvanized Sheet Steel: 0.0396” thick.

2.08 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F.
2. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F.
3. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
    b. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT.
    c. Henry Company; Blueskin PE200 HT.
    d. Metal-Fab Manufacturing, LLC; MetShield.
    e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

B. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

2.09 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

B. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

C. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.10 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Coil-Coated Aluminum Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.

1. Examine walls, roof edges, and parapets for suitable conditions for manufactured roof specialties.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if recommended by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under flashings.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

B. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

C. Apply slip sheet, wrinkle free, over underlayment, before installing sheet metal flashing and trim.

3.03 INSTALLATION, GENERAL

A. General: Install manufactured roof specialties according to manufacturer's written instructions.

B. Anchor manufactured roof specialties securely in place and capable of resisting forces specified in performance requirements. Use fasteners, separators, sealants, and other miscellaneous items as required to complete manufactured roof specialty systems.

1. Install manufactured roof specialties with provisions for thermal and structural movement.
2. Torch cutting of manufactured roof specialties is not permitted.
3. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
4. Provide uniform, neat seams with minimum exposure of solder and sealant.
5. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
6. Do not use graphite pencils to mark metal surfaces.
7. Install water cut-offs, as recommended by membrane manufacturer, under the anchor bar.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum or stainless-steel manufactured roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing exposed-to-view components of manufactured roof specialties directly on cementitious or wood substrates, install a course of felt/synthetic underlayment and cover with a slip sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

D. Expansion Provisions: Provide for thermal expansion of exposed manufactured roof specialties.

E. Space movement joints at a maximum of 12 feet with no unplanned joints within 18 inches of corners or intersections.

1. When ambient temperature at time of installation is between 40 and 70 degrees Fahrenheit, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

F. Fasteners: Use fasteners of type and size recommended by manufacturer but of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws or as recommended by fastener manufacturer to achieve maximum pull-out resistance.

G. Seal concealed joints with butyl sealant as required by manufacturer of roofing specialties.

H. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 degrees Fahrenheit.

3.04 COUNTERFLASHING AND REGLET INSTALLATION

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Embedded Reglets: Installation of reglets is specified in Division 04 Section “Unit Masonry”.

C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.

D. Counterflashings: Coordinate installation of counterflashings with installation of base flashings. Insert counterflashings in reglets or receivers and fit tightly to base flashings. Extend counterflashings 4 inches over base flashings. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric or butyl sealant.

3.05 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. General: Install gutters and downspouts to produce a complete roof drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Installation of Hung Gutters: Install gutter full length of roof at eaves.

1. Install gutter hanger brackets 3 feet on center. Install the brackets so there will be a slight pitch in the gutter towards the downspouts.
2. Join the gutter sections, end pieces, mitered corners, and outlet tubes.
3. Install expansion joints between the downspouts at maximum intervals of 48 feet.

a. Form the expansion joints with end baffles conforming to the shape of the gutter. Join the baffles to the gutter section.
b. Install a cover plate over the baffle.

4. Install a continuous stiffener bar along the top front edge of the gutter. Fold the gutter around the stiffener bar so it is securely locked in place.
5. Install gutter braces 3 feet o.c., staggered from the gutter hanger brackets. Secure the braces to the stiffener bar and to the back vertical portion of the gutter with brass or copper bolts.
6. Secure the top back edge of the gutter to the wood fascia, or provide acceptable means of hanging gutter from the roof deck if fascia is not sufficient to support gutter.

C. Installation of Downspouts: Install downspouts at each end of the gutter run as exists currently on the building. Place downspout for straight drop to grade with offsets as required for installation.

1. Join the downspout sections with end joints that telescope at least 1-1/2 inches.
2. Install necessary offsets and elbows.
3. Secure downspout with hangers 5'x 0" o.c. and with a minimum of 2 hangers at each downspout section. Form hangers to keep downspouts 1 inch away from wall.
4. Fasten downspouts to hangers with sheet metal screws.
5. Secure hangers to masonry and concrete walls with machine bolts in lead shields and to wood walls with screws.
6. Connection to Underground Drains: Fit the downspout neatly into the drain pipe or boot. Caulk the joint with lead wool and seal with sealant. Where drain pipe doesn't exist, provide turn out at bottom of downspout for drainage onto splash pan.

3.06 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Remove temporary protective coverings and strippable films as manufactured roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

C. Replace manufactured roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 72 00

ROOF ACCESSORIES

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Roof hatches.
2. Roof curbs.
3. Piping portals and flashings.
4. Equipment supports.

B. Related Sections include the following:

1. Section 05 50 00 – Metal Fabrications for ladders and miscellaneous metal framing and supports.
2. Section 06 10 00 – Rough Carpentry for wood cants, and wood nailers.
3. Section 07 62 00 – Sheet Metal Flashing for shop- and field-fabricated metal flashing and counter-flashing, scuppers, gutters and downspouts, fasciae, roof expansion-joint covers, valleys, and miscellaneous sheet metal trim and accessories.
4. Section 07 72 00 – Roof Accessories included as part of roofing Work.
5. Section 09 91 00 – Painting for shop primers and field painting.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other Work.

C. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for roof accessories with factory-applied color finishes.

1.03 QUALITY ASSURANCE

A. Standards: Comply with the following:

1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Roof Curbs and Equipment Supports:

a. AES Industries, Inc.
b. Curbs Plus, Inc.
c. Custom Curb, Inc.

d. Goeller Enterprises.
e. L & M Curb.
f. Loren Cook Company.
g. Roof Products & Systems Corp.

2. Piping Portals and Flashings

a. Custom Curb, Inc.
b. L & M Cuyrb.
c. Portals Plus, Inc.
d. Roof Products & Systems Corp.

3. Roof Hatches:

a. Babcock-Davis Hatchways, Inc.
b. Bilco Company.
c. Custom Curb, Inc.
d. Goeller Enterprises.
e. J. L. Industries, Inc.
f. Milcor, Inc.
g. Nystrom Products Co.
h. O'Keeffe's Inc.

2.02 MATERIALS, GENERAL

A. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M with Class AZ-50 coating, structural quality, Grade 40, or as required for strength.

B. Aluminum Sheet: ASTM B 209 for alclad alloy 3005H25 or alloy and temper required to suit forming operations, with mill finish, unless otherwise indicated.

C. Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of thickness indicated.

D. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.

E. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

1. Where removing exterior exposed fasteners affords access to building, provide nonremovable fastener heads.

F. Boots: Manufacturer’s standard EPDM design, minimum .060 inch thick, with stainless steel banding ring or other approved compression method.

G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

H. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coating.

I. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

J. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.

K. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.03 ROOF CURBS

A. General: Provide roof curbs capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.90-inch-thick, structural-quality, aluminum sheet, fabricate with welded corner joints.

1. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
2. Provide manufacturer's standard rigid or semirigid insulation where indicated.
3. Provide formed cants and base profile coordinated with roof insulation thickness.
4. Fabricate units to minimum height of 8 inches, unless otherwise indicated.

2.04 PIPING PORTALS AND FLASHINGS

A. General: Provide portals capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.0747-inch-thick, structural-quality, hot-dip galvanized or aluminum-zinc alloy-coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints.

1. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
2. Provide manufacturer's standard rigid or semirigid insulation where indicated.
3. Provide formed cants and base profile coordinated with roof insulation thickness.
4. Fabricate units to minimum height of 8 inches, unless otherwise indicated.

2.05 EQUIPMENT SUPPORTS

A. General: Provide equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.0747-inch-thick, structural-quality, hot-dip galvanized or aluminum-zinc alloy-coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints.

1. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
2. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
3. Fabricate units to minimum height of 8 inches, unless otherwise indicated.
4. Sloping Roofs: Where slope of roof deck exceeds 1/4 inch per foot, fabricate support units with height tapered to match slope to level tops of units.

2.06 ROOF HATCHES

A. General: Fabricate units to withstand 40-lbf/sq. ft. external and 20-lbf/sq. ft. internal loading pressure. Frame with minimum 9-inch- high, integral-curb, double-wall construction with 1-1/2-inch insulation, formed cants and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints. Provide double-wall cover (lid) construction with 1- inch- thick insulation core. Provide gasketing and equip with corrosion-resistant or hot-dip galvanized hardware including pintle hinges, hold-open devices, interior padlock hasps, and both interior and exterior latch handles.

1. Telescoping Extension Post: Provide telescoping extension post which permanently mounts to top 2 rungs of ladder with clamp brackets and extends 42-inches above ladder, locking into position. Hot-dip galvanized finish.

B. Type: Single-leaf personnel access.

1. For Ladder Access: 30 by 36 inches.

C. Material: Galvanized steel sheet curbs and aluminum covers (lids).

1. Finish: High-performance organic coating.

2.07 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.08 GALVANIZED STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

B. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply the air-dried primer specified below immediately after cleaning and pretreating.

1. Shop Primer: Exterior galvanized metal primer per Division 09, Section "Painting."

C. High-Performance Organic Finish: Cleaned and primed with inhibitive primer and organic coating as specified below. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 621 for coil-coated sheets.

a. Color and Gloss: Match Architect's custom sample.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.

B. Install roof accessory items according to construction details of NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated,

C. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

D. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

E. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counterflashing). Seal overlap with thick bead of mastic sealant.

F. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.02 CLEANING AND PROTECTION

A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes joint sealants and fillers for the applications specified with the products in this Section and as indicated on Drawings. Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Joint sealants and fillers, interior and exterior including silicone, urethane and latex joint sealants.

B. Related Sections:

1. Section 08 80 00 - Glazing for glazing sealants.
2. Section 09 29 00 - Gypsum Board for acoustical joint sealants.
3. Section 09 30 00 - Tiling for sealing tile joints.

1.02 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.03 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 - Submittals Procedures.

B. Submit product data including catalog cuts, specification data, installation details, and manufacturer's certificate for each type of sealant required under the provisions of Section 01 33 00 - Submittal Procedures.

C. Product/Location List: Submit for approval a detailed list of locations where materials will be used, types of sealants which will be used at each location, and names of manufacturers of compounds, primers, and fillers which will be used. Submit manufacturer's certificate attesting that their products comply with specification requirements and are suitable and recommended for the use indicated.

D. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

E. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

F. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and testing agency.

B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

F. Field-Adhesion Test Reports: For each sealant application tested.

G. Warranties: Sample of special warranties.

1.05 QUALITY ASSURANCE

A. Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

D. Preinstallation Conference: Conduct conference at Project site.

1.06 MOCKUPS

A. Mockups and Sample Installations: Provide mockups and sample installations of sealants at locations indicated or required by the Architect.

B. Mockups and sample installations shall represent the primary types of materials, substrate surfaces, joint size, exposure, and other conditions to be encountered in the work.

C. Preparation, priming, application. and curing, shall comply with manufacturer's recommendations and actual proposed methods.

D. Schedule the applications, with allowance for sufficient curing time, so that samples may be examined and necessary adjustments made at least 1 week prior to date scheduled for commencing installation of the work.

1. The mockups and sample installations shall be visually examined for staining, dirt pickup, shrinkage, color, general workmanship and appearance. Cut and pull the sealant from each sample joint to examine for internal bubbles or voids, adhesion, and general compatibility with substrate.

1.07 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing (All Exterior Wall and Exterior Assembly Sealants Only) : Submit to joint sealant manufacturers, prior to full size building sample installation(s), samples of materials that will contact or affect, by direct or indirect chemical or mechanical means, exterior wall joint sealants for compatibility and adhesion testing below.

1. General: Test results confirming compatibility and adhesion are mandatory for all concealed and exposed sealant materials in contact with exterior glazing, curtainwall framing, exterior precast, exterior stone cladding, metal panels, face brick, other sealants, flashings, metal framing, and shims, prior to the construction of full sized sample installation(s).

a. Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the work.
b. Investigate materials that fail compatibility and adhesion testing and obtain sealant manufacturer's written recommendations for corrective measures, which may include the use of primers, cleaners, cleaning measures, curing time, temperature limitations (surface and air), humidity conditions, moisture content of substrate, etc.
c. Definitions:

1) Compatibility: The capability of the sealant materials and substrates to be placed in direct contact with each other and maintain their required physical, chemical and visual qualities with the absence of softening, staining, oil exudation, discoloration or other detrimental, deleterious or degradative effects caused by chemical interactions.
2) Adhesion: The mechanical or chemical ability of the sealant materials and substrates to adhere or bond together at their interface.

2. Adhesion in Peel Testing:

a. Test Methods:

1) Comply with ASTM C794 'Adhesion and Peel of Elastomeric Joint Sealants'. modified to include project specific substrates and to report cohesive or adhesive failure mode. Samples of each exterior precast, exterior stone cladding, exterior face brick, other sealants, flashings, metal framing in contact with the concealed and exposed sealant materials are required to be tested.
2) Comply with ASTM C1135 'Determining Tensile Adhesion Properties of Structural Sealants', modified to include project specific substrates and the following. Sealant manufacturer's modified interpretations of ASTM C 1135 will not be permitted. Samples of each exterior structural glazing and metal framing in contact with the structural sealant materials are required to be tested. In addition to the testing being performed under the standard environmental conditioning required of ASTM C1135; the Contractor shall prepare, and test, additional specimens for each project specific environmental condition under which the sealant will be applied and cured.

b. All specimens shall be tested for primed and unprimed performance.
c. Report:

1) Date(s) of testing.
2) Project identification.
3) Test method (as identified herein).
4) Specimen substrate(s) tested.
5) Sealant(s) tested.
6) Substrate preparation (cleaning materials, methods and primers used).
7) Test results for each specimen tested (type of failure - adhesive or cohesive-force measured at failure in pounds per lineal inch).
8) Recommendations. Where testing shows equal or better performance without a primer, a primer will not be required.
9) Additional remarks, if any (i.e., color change of substrate or sealant, voids in the body of the sealant when examined in cross section, blistering. bubbling, sealant softening, or evidence of improperly mixed or cured sealant).

3. Preconstruction Field-Adhesion Testing: Before installing exposed exterior elastomeric sealants, field test their adhesion to joint substrates as follows:

a. Locate test joints where indicated or, if not indicated, as directed by Architect.
b. Conduct field tests for each type of exposed exterior elastomeric sealant and joint substrate indicated.

1) Perform 10 tests for the first 1000 feet of joint length for each type of exposed exterior wall sealant and joint substrate.
2) Perform one test for each 1000 feet of joint length thereafter.

c. The Architect and manufacturer's technical representative, shall be present when joints are tested.
d. Test Method: Test exterior elastomeric joint sealants by hand-pull method described below:

1) Install joint sealants in 60-inch long joints using same materials and methods for joint preparation and joint-sealant installation in accordance with manufacturer's final laboratory testing recommendations. Allow sealants to cure.
2) Make knife cuts from one side of joint to the other, followed by two cuts approximately 3-inch) long at sides of joint and meeting cross cut at one end. Place a mark l-inch from cross-cut end of 3-inch piece.
3) Use fingers to grasp 3-inch piece of sealant between cross- cut end and l-inch mark; pull firmly down at a 90-degree angle to the joint and hold sealant in this position for

ten seconds; following the ten second time duration pull sealant at a 180 degree angle parallel to the joint and hold the sealant in this position for ten seconds. Pull sealant away from joint to the distance recommended by sealant manufacturer for testing adhesion.

4) Repair joint as recommended by the sealant manufacturer.

e. Sealants evidencing adhesive failure with one or both substrates during testing, and/or a level of elongation prior to failure that is not in compliance with the performance characteristics specified herein or otherwise published by the sealant manufacturer will be subject to rejection by the Architect. Discontinue use of joint sealants, cleaning agents, primers, and application methods associated with failures documented during testing and immediately notify manufacturer and Architect for further review.

4. Report: Provide written summary of each compatibility and adhesion test.

1.08 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

B. Apply joint sealants as late as possible in the construction, preceding application of water repellent coatings if any, and painting and following cleaning operations.

C. Do not install solvent curing sealants in unventilated building spaces.

1.09 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period Silicone Sealants: 20 years from date of Substantial Completion.
2. Warranty Period Urethane Sealants: 5 years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 – GENERAL

2.01 MANUFACTURERS

A. Specified Manufacturers and Products: To establish a standard of quality, design and function desired, Drawings and specifications have been based on the products specified under this section for each individual sealant type, for the applications scheduled at the end of Section, and as may be additionally identified on the Drawings.

B. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:

1. Bostik, Middleton, MA
2. Dow, Midland MI.
3. GE Silicones, Waterford NY.
4. Pecora Corporation, Harleysville PA.
5. Sika USA Corp, Lyndhurst NJ.
6. Tremco, Inc., Beachwood OH.

2.02 JOINT SEALANT MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.

D. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

E. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

F. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

G. Colors of Exposed Joint Sealants: Match Architect's samples.

2.03 SILICONE JOINT SEALANTS

A. Sealant Materials, General Requirements:

1. Only use sealant and primers that comply with the following limits for VOC content:

a. Architectural Sealants: 250 g/L.
b. Roofing Sealants: 450 g/L.
c. Roadway Sealants: 250 g/L.
d. Sealant primer: 250 g/L.

B. Joint Sealer **Type SC** (Silicone, general construction): One-part medium modulus, neutral-cure, synthetic sealant, having a useful life expectancy of at least 20 years, conforming to ASTM C 920, Type S, Grade NS, Class 50, use NT, with a minimum movement capability of ±50 percent, equal to the following:

1. Dow "Dowsil 756 SMS"
2. GE Silicones, "Silpruf LM SCS 2700"
3. Pecora, product, "895 NST"
4. Sika USA Sikasil WS 290 or WS 295
5. Tremco Commercial Sealants & Waterproofing: Spectrem 3

a. Volatile Organic Compound (VOC) Content: 20 g/L maximum.
b. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
c. Staining, ASTM C 1248: None on concrete, marble, granite, limestone, and brick.

d. Color: As selected by Architect from manufacturer's standard line of not less than 15 colors.

C. Joint Sealer **Type SE** (Silicone, Exterior construction): Ultra low-modulus, high-performance, one-part, moisture-curing silicone joint sealant, having a useful life expectancy of at least 20 years, conforming to ASTM C 920, Type S, Grade NS, Class 100/50, Use NT, equal to the following:

1. Dow Corning, product, "790"
2. Sika, product "Sika Sil-C 990"
3. Momentive product "Silopruf LM SCS 2700"
4. Tremco, product "Spectrem 1"
    a. Volatile Organic Compound (VOC) Content: 1 g/L maximum.
    b. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
    c. Staining, ASTM C 1248: None on concrete, marble, granite, limestone, and brick.
    d. Color: As selected by Architect from manufacturer's standard line of not less than 12 colors.
5. Pecora product "890"

D. Joint Sealer **Type ST** (Silicone, color Tintable): Multi-component, neutral-curing, nonstaining, low dirt pick up, low-modulus silicone sealant having a useful life expectancy of at least 20 years, conforming to ASTM C 920, Type S, Grade NS, Class 50, Use NT, M, G, A, and O, with a minimum movement capability of +/- -50 percent, equal to the following:

1. Tremco, product "Spectrem 4-TS"
    a. Volatile Organic Compound (VOC) Content: 20 g/L maximum.
    b. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
    c. Staining, ASTM C 1248: None on concrete, marble, granite, limestone, and brick.
    d. Color: As selected by Architect from manufacturer's standard line of not less than 70 colors.
2. Dow Corning product "756SMS"
3. Momentive product "Silpruf NB SCS9000"
4. Pecora, product, "890 FTS"

E. Joint Sealer **Type SG** (Silicone, color (manufacturer standard): Single-component, neutral-curing, water-resistant, low-modulus silicone sealant conforming to ASTM C 920, Type S, Grade NS, Class 25, Use NT, G, A, , with a minimum movement capability of +/-25 percent, equal to the following:

1. Dow Dowsil product “1199”
    a. Volatile Organic Compound (VOC) Content: 44.6 g/L maximum.
2. Tremco, product “Tremsil 600”
3. GE product “Silglaze 2800”

2.04 URETHANE JOINT SEALANTS

A. Joint Sealer **Type HL1** (Horizontal-self-Leveling, 1-component): Pouring grade self-leveling modified urethane or neutral cure silicone sealant, ASTM C 920 Uses T and NT, Type S, Grade P, Class 25, with a minimum movement capability of ±25 percent, equal to the following:

1. BASF, product, "MasterSeal SL1"
2. Sika, product, "Sikaflex 1cSL"
3. Tremco, product "Vulkem 45" / 45 SSL
4. Pecora product "Urexspan NR-201
5. Bostik product "Chem-Calk 955SL

B. Joint Sealer **Type HL2** (Horizontal-self-Leveling): Two-part, moisture-curing, low-modulus polyurethane sealant with a tintable base sealant, ASTM C 920, Type M, Grade P, Class 35; Uses T, O, and I, with a minimum movement capability of ±25 percent, equal to the following:

1. BASF, product "MasterSeal SL2"
2. Sika Corp., product, "Sikaflex 2cSL"
3. Tremco, product, "Vulkem 445SSL"
    a. Tensile Strength, ASTM D 412: 250 psi (1.7 MPa), at 100 percent elongation.

b. Tear Strength, ASTM D 412: 35 pli (6.1 kN/m).
c. Adhesion to Concrete, After Water, ASTM C 794: 28 pli (4.4 kN/m)
d. Hardness, ASTM C 661: 40 durometer Shore A, minimum.
e. Accelerated Weathering, ASTM C 793: Pass.
f. Volatile Organic Compound (VOC) Content: 106 g/L maximum.
g. Color: As selected by Architect from manufacturer's standard line of 70 colors

4. Pecora Chemical Corp. product "DynaTrol II-SG"

C. Joint Sealer **Type HT** (Horizontal-Trowel): Trowel grade multi-component modified-urethane or neutral-cure silicone paste sealant, conforming to ASTM C 920, with a minimum movement capability of ±25 percent, equal to the following:

1. BASF, product "MasterSeal SL2 (slope grade)"
2. Pecora, product "Dynatred"
3. Sika, product "Sikaflex 2CTG"
4. Tremco, product "THC-901"

D. Joint Sealer **Type P1** (Polyurethane 1-component): Low modulus single component gun- grade polyurethane sealant, non-sagging, conforming to ASTM C920, Type S, Grade NS, Class 35, with a minimum movement capability of ±35 percent, equal to the following:

1. BASF, product "MasterSeal NP1"
2. Pecora, product "Dynatrol I"
3. Sika, product "Sikaflex 1a"
4. Tremco, product "Dymonic FC"

a. Extrusion Rate ASTM C1183: 93.1 mL/min
b. Weight Loss ASTM C1246: Pass
c. Tack Free Time ASTM C679: 3 to 4 hr
d. Volatile Organic Compound (VOC) Content: 10 g/L maximum.
e. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
f. Color: As selected by Architect from manufacturer's standard line of not less than 15 colors.

5. Bostik product "Chem-Calk 900"

E. Joint Sealer **Type P2** (Polyurethane, Multi-component): Low modulus type, Multi-component non-sagging gun-grade polyurethane sealant, conforming to FS TT-S-000227E, Type II, Class A, and ASTM C 920, Type M, Class 25, Grade NS, uses T and NT, with a minimum movement capability of ±25 percent, equal to the following:

1. BASF, product "MasterSeal NP2"
2. Tremco, product "Vulkem 227"
3. Pecora, product "Dynatred"
4. Sika, product "Sikaflex 2c NS"

2.05 LATEX JOINT SEALANTS

A. Joint Sealer **Type AA** (Acrylic acoustical): One component acrylic latex, permanently elastic, non-staining, non-shrinking, non-migrating and paintable, and recommended for sealing interior concealed joints to reduce transmission of air-borne sound.

1. Tremco, product "Tremco Acoustical Sealant"
2. USG, product "USG Acoustical Sealant"
3. Pecora, product " AIS-919"
4. Momentive product "RCS20"

B. Joint Sealer **Type AP** (Acrylic latex or siliconized acrylic latex): One component acrylic latex caulking compound, conforming to ASTM C 834 Type P, Grade NF, for use NT; paintable within 24 hours after application, with a minimum movement capability of ±12.5 percent, equal to one of the following:

1. BASF, product, "Sonolac"
2. Tremco, product, "Tremflex 834"
3. Bostik, product, "Chem-Calk 600"
4. Pecora, product " AC-20+"

2.06 MILDEW-RESISTANT JOINT SEALANTS

A. Joint Sealer **Type SF** (Silicone, Food contact): One component silicone rubber, acceptable to local health officials, conforming to U.S. Food and Drug Administration regulation 21 CFR 175.105 and 175.300, FS TT-S-001543A, Type Non-Sag, Class A, and ASTM C 920, Type NS, Class 25, Use NT, G, O and A with a minimum movement capability of ±25 percent, and a Shore A minimum hardness of 20, equal to the following:

1. Dow Corning, product, "732"
2. GE Silicones, product "Series SCS1000"

B. Joint Sealer **Type SM** (Silicone, Mildew-resistant): One-part. ASTM C 920, Type S, Grade NS, Class 50, for use NT, minimum movement capability of ±50 percent, and a Shore A hardness of 20, equal to the following:

1. BASF, product "MasterSeal NP 150"
2. Dow Corning, product "786 Mildew-resistant"
3. Momentive product "SCS1700 Sanitary"
4. Tremco, product "Tremsil 200 Sanitary"
5. Pecora, "898NST"

2.07 MISCELLANEOUS JOINT SEALANTS

A. Joint Sealer **Type B** (Butyl): Gun-grade modified butyl and polyisobutylene sealant, conforming to ASTM C-1311, with a movement capability of ±10 percent or better and a Shore A hardness of 24 to 28, equal to one of the following:

1. Tremco, product "Butyl Sealant"
2. Pecora, product "BC-158"

B. Joint Sealer **Type BP2** (Bitumen modified polyurethane, Multi-component): Pouring grade self-leveling bitumen modified two component urethane sealant, conforming to ASTM C920, Type M, Grade P, Class 25 with a minimum movement capability of +50/-25 percent, equal to one of the following:

1. BASF, product "MasterSeal CR125"
2. Pecora, product "Urexpan NR-300"
3. Tremco, product "Vulkem 202"

C. Joint Sealer **Type FS** (Expanding Foam Sealant): Open cell polyurethane foam impregnated h an acrylic-polymer-modified, non-drying water-based asphalt emulsion.

1. Impregnation agent to have proven non-migratory characteristics
2. Compression when expanded in joint shall be at approximately 25% of its uncompressed dimension (4x compression).
3. Material to be supplied in sticks or rolls, precompressed to less than joint size at mean temperature for ease of installation
    a. Roll material will contain a nylon mesh (to reduce stretching) embedded into a pressure-sensitive adhesive on one side of the material
    b. Stick material to contain a pressure-sensitive adhesive on one face for aide in application
4. Acceptable Products:
    a. Emseal, product "25V
    b. Polytite, product "Polytite B"
    c. Sandell, model "Polyseal"

D. Joint Sealer **Type PE** (Polyether): Low modulus type, Single-component non-sagging gun- grade, low-odor, neutral curing polyether, sealant, conforming to ASTM C920, Type S, Grade NS, Class 50, Use NT with a minimum movement capability of ±50 percent, equal to the following:

1. BASF, product, "MasterSeal 150"
2. STS Coatings, product "GreatSeal PE-150" Sealant.
3. Chem Link, product "MetaLink"
4. York Manufacturing, product: "PE-150 Liquid Tape"

2.08 ACCESSORIES

A. Compressible joint bead back-up: Compressible closed cell polyethylene, extruded polyolefin or polyurethane foam rod complying with ASTM C 1330, Type C, 1/3 greater in diameter than width of joint. Shape and size of compressible back-up shall be as recommended by manufacturer for the specific condition used. Provide one of the following, or equal.

1. Nomaco, Inc., Zebulon, NC, product "Green Rod"
2. Industrial Thermo Polymers Ltd., Brampton, Ontario CN, product "ITP Standard Backer Rod"
3. BASF Construction Systems, product "MasterSeal 920 and 921"
4. W.R. Meadows Inc., Hampshire, IL, product "Sealtight Kool-Rod"

B. Type B: Bi-cellular reticulated, polymeric foam material with a surface skin, nonoutgassing, with a density of between 1.5-3.0 pcf (24-48 kg/cubic meter) per ASTM D1622 and minimum tensile strength of greater than 29 - 38 psi (200 - 267 kPa) per ASTM D1623, and with water absorption less than 0.058 oz./cubic inch (0.10 gm/cc) per ASTM C1016; one of the following:

1. SOFROD; Nomaco, Inc.
2. Soft Backer-Rod; BASF.

C. Primers: Furnish and install joint primers of the types, and to the extent, recommended by the respective sealant manufacturers for the specific joint materials and joint function.

D. Bond-breaker tape, and temporary masking tape: Of types as recommended by the manufacturer of the specific sealant and caulking material used at each application, and completely free from contaminants which would adversely affect the sealant and caulking materials. Provide self-adhesive tape where applicable.

2.09 MISCELLANEOUS MATERIALS

A. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surfaces adjacent to joints to which it is applied.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. General:

1. Weather conditions must be dry and of the temperature, as recommended by sealant manufacturer, during application operations.
2. Surface receiving work of this section must be absolutely dry and dust free. All joints receiving sealant/caulking materials and primers shall be subject to the approval of the sealant manufacturer for proper use of specified materials.

B. Thoroughly clean all joints, removing all loose mortar, oil, grease, dust, frost, and other foreign materials that will prevent proper adhesion of primers and sealant materials.

1. Clean ferrous metals of all rust and coatings by wire brush, grinding or sandblasting.
2. Remove oil, grease and protective coatings with cleaners recommended by sealant manufacturer.

C. Prime joint substrates, as recommended in writing by joint-sealant manufacturer, as based on preconstruction joint-sealant-substrate tests or as based upon prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

D. Verify that joint backing and release tapes are compatible with sealant.

E. Perform preparation in accordance with ASTM C 804 and C 790 for solvent and latex base solvents, respectively.

3.03 INSTALLATION

A. General: Conform to SWRI requirements, and sealant manufacturer's written requirements for installation.

B. Install joint bead back-up in all joints in excess of 5/8-inch depth, and joints that have no back-up therein, placing the joint bead in the joint in a manner that will assure a constant depth 1/8 inch greater than the sealant and caulking material depth tolerances.

1. Set beads into joints continuously, by slightly stretching during placement, to permit compression against sides of joint, without surface wrinkles or buckles.
2. Do not stretch back-up material into joints.

C. Install bond breaker in joints where shown in the Drawings and wherever recommended by the sealant manufacturer to prevent bond of the sealant to surfaces where such bond might impair the Work.

D. Apply masking tape or other precautions to prevent migration or spillage of materials onto adjoining surfaces.

E. Apply urethane sealant and latex caulking materials into joints in accordance with manufacturer's instructions, using mechanical or power caulking gun equipped with nozzle of appropriate size, with sufficient pressure to completely fill the joints.

1. The depth of sealant and caulking materials shall be in accordance with manufacturer's recommendations for the specific joint function, but in no case exceed 1/2-inch in depth, nor less than 1/4-inch, regardless of the joint width.
2. Maintain the outer edge of the sealant and caulking materials, where side faces of joints are in the same plane, back 1/8-inch from the faces.
3. Apply sealant in continuous beads without open joints, voids or air pockets so as to provide a watertight and airtight seal for the entire joint length.
4. After placement of the sealant and caulking materials, concave-tool the surfaces to uniform density, using a water-wet tool. Do not use detergents or soapy water for the tooling operations.
5. Remove the temporary masking tape immediately after tooling, and before the sealant or caulking material has taken initial set.

F. Take care not to block-off weep tubes or any through wall opening constructed to allow weeping of accumulated water.

G. Apply pouring self-leveling urethane sealant (Sealant designation HL) into horizontal joints in accordance with manufacturer's instructions, to a level approximately 1/16 inch below adjacent surfaces.

1. Apply sealant without open joints, voids or air pockets so as to provide a watertight and airtight seal for the entire joint length.
2. After placement of the sealant and caulking materials, concave-tool the surfaces to uniform density, using a water-wet tool. Do not use detergents or soapy water for the tooling operations.
3. Remove the temporary masking tape immediately after tooling, and before the sealant has taken initial set.

3.04 INSTALLATION PRE-FORMED FOAM SEALANTS

A. General: The joint configuration and the joint surfaces shall be as detailed in the Drawings and in accordance with the current material Tech Data available from the Manufacturer. Field measurements of the depth and width of the joint shall be supplied to manufacturer before material is ordered.

B. Joint sealer/expansion joint material to be installed in strict accordance with the manufacturer's instructions.

1. Installed each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material.
2. Install in manner to provide seal continuity at ends, turns and intersections of joints.
3. Provide additional wet seal joints where required by manufacturer.

C. Remove all strip-off waste materials and excess foam sealant from site immediately upon completion of work.

3.05 CLEANING

A. Clean all surfaces of adjacent surfaces which have been marked or soiled by the work of this Section, removing all excess sealant and caulking materials with solvents which will not damage the surfaces in any way.

3.06 PROTECTION

A. During the operation of sealant work, protect the work of other trades against undue soilage and damage by the exercise of reasonable care and precautions. Repair or replace any work so damaged and soiled.

3.07 SCHEDULE

A. General: Seal joints indicated and all interior and exterior joints, seams, and intersections between dissimilar materials.

B. Items Not to be Sealed:

1. Joints and penetrations in exterior gypsum sheathing. Use joint sealant as specified in Division 06 Section “Gypsum Sheathing.”
2. Joints covered by joint covers and seals specified in Division 07 Section “Expansion Joint Cover Assemblies.”
3. Penetrations in fire-rated assemblies. Use firestop sealants as specified in Division 07 Section “Penetration Firestopping.”
4. Joints in and perimeter of fire-rated assemblies. Use firestop sealants as specified in Division 07 Section “Fire-Resistant Joint Sealants.”
5. Joints, perimeter, and penetrations in sound-rated assemblies. Use acoustical sealant specified with sound-rated assembly in Division 09 Section “Gypsum Board.”
6. Weep holes in masonry, storefront, and windows.

C. Sealant Colors:

1. Colors for Sealant Types "P2" and "HL2": Match colors furnished by the Architect, or match other building materials as directed. Should such custom colors not be available from the approved manufacturer, except at additional charge, provide all such colors at no change in Contract Sum.
2. Colors for Sealant Types "BP2", "P1", "HL1", "HT", "SC", "SE", and "SM": As selected by the Architect from manufacturer's standard colors.
3. Color for Sealant Types "AA" and "AP": White.
4. Color for Sealant Type "B": Black.
5. Color for Sealant Type "PE": Black.
6. In concealed installation, and in partially or fully exposed installation where so approved by the Architect, standard gray or black sealant may be used.

D. Specialty Joint Conditions:

1. Sealing termination bars and through-wall flashing in cavity walls: Sealant type: PE.

E. Exterior joints (Listed by primary building material abutting sealant joints):

1. Concrete (including precast):

JOINT CONDITION	SEALANT TYPE
Concrete to concrete, vertical control joints:	SE or ST
Concrete foundation walls to abutting concrete, and other non-	HL2

bituminous pavements, steps, platforms, and ends of ramp, (horizontal joints):	
Concrete slabs on grade to abutting non-bituminous pavements (horizontal joints, including pedestrian traffic surfaces)	HL2
Concrete to concrete saw cut and tooled control and isolation joints in horizontal surfaces including pedestrian traffic surfaces	HL1 or HL2
Concrete and non-bituminous sloped (5% to 12%) pavement ramps (horizontal joint) at abutting concrete or masonry foundation walls	HT
Concrete to all items which penetrate exterior concrete walls, including, but not necessarily limited to, door frames, louver frames, pipes, vents, and similar items	P1

2. Exterior Masonry:

JOINT CONDITION	SEALANT TYPE
Masonry to masonry, expansion and control joints	SE
Masonry to abutting non-porous materials (painted metals, anodized aluminum, mill finished aluminum, PVC, glass, and similar materials):	SE or ST
Masonry to abutting masonry, stone or concrete:	SE
Masonry to all items which penetrate exterior masonry walls, including, but not necessarily limited to, door frames, louver frames, pipes, vents, and similar items	SE or ST

3. Exterior Metal:

JOINT CONDITION	SEALANT TYPE
Metal to Metal	SE or ST
Metal to Glass	SE or ST

4. Glazing Sealant:

JOINT CONDITION	SEALANT TYPE
Glazing setting, backbedding sealant on wood sash	SG

F. Interior joints (Listed by primary building material abutting sealant joints):

1. Interior Concrete:

JOINT CONDITION	SEALANT TYPE
Concrete to concrete (including precast), vertical joints:	SC
Concrete to concrete: horizontal walkable surfaces:	HL2
Concrete and non-bituminous pavement ramps (5 to 12 Percent) horizontal joints at abutting vertical concrete or masonry surfaces:	HT
Concrete to all items which penetrate concrete walls, including, but not necessarily limited to, door frames, louver frames, pipes, vents, and similar items	SC
Precast concrete to abutting materials (vertical joints):	SC

2. Interior Masonry: * Includes interior side of exterior masonry walls

JOINT CONDITION	SEALANT TYPE
Masonry to masonry control joints	P2
Masonry to Gypsum Board	SC
Masonry to all items which penetrate masonry walls, including, but not necessarily limited to, window frames, door frames, louver frames, and similar items:	SC
Masonry to all pipes, conduit and vents which penetrate non-rated masonry walls	SC

3. Gypsum Board:

JOINT CONDITION	SEALANT TYPE
Gypsum board to metal or wood trim:	AP
Gypsum board to abutting surfaces at exposed tops and bottoms partitions and walls	AA
Gypsum board to masonry:	SC
Gypsum board to interior door and window frames, penetrating conduits and piping, light-fixtures, electrical cover plates, building specialty items, ductwork, grilles, supply diffusers, faucets, piping, escutcheon plates and similar items	AP
Gypsum board to plumbing fixtures:	SM

4. Architectural Millwork and Casework:

JOINT CONDITION	SEALANT TYPE
Casework to abutting materials, kitchens, toilet rooms and similar "wet spaces":	SM
Casework to abutting surfaces (except in "wet" spaces):	AP
Countertops to abutting wall surfaces and to abutting casework:	SM
Countertops to plumbing fixtures and fittings:	SM

5. Interior Metal:

JOINT CONDITION	SEALANT TYPE
Metal to metal	SC
Bedding of metal thresholds	B

6. Interior Floor Drains:

JOINT CONDITION	SEALANT TYPE
Floor drains to concrete slab	P2
Floor drains to resilient sheet flooring	P2

7. Acoustical ceilings:

JOINT CONDITION	SEALANT TYPE
Acoustical ceiling edge angle to irregular wall surface	AP

8. Tile:

JOINT CONDITION	SEALANT TYPE
Tile to tile vertical, and horizontal non-traffic joints:	SM
Tile to tile, horizontal pedestrian traffic joints:	HL2

9. Interior Wood:

JOINT CONDITION	SEALANT TYPE
Wood to wood (natural or stained finishes)	SC
Wood to wood (painted opaque finishes)	AP or SC
Wood to metal	SC
Wood base to wall surfaces	SC

END OF SECTION

SECTION 07 95 00

EXPANSION CONTROL

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Architectural joint systems for building interiors.

1.02 DEFINITIONS

A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage (plus or minus) of nominal value of joint width.

D. Nominal Joint Width: The width of the linear opening specified in practice and in which the joint system is installed.

1.03 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit copies of manufacturer’s latest published literature for materials specified herein for approval and obtain approval before materials are fabricated and delivered to the site. Data to clearly indicate movement capability of cover assemblies and suitability of material used in exterior seal for UV exposure.

C. Shop Drawings: Provide the following for each joint system specified:

1. Placement Drawings: Include line diagrams showing plans, elevations, sections, details, splices, blockout requirement, entire route of each joint system, and attachments to other work. Where joint systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain interior architectural joint systems through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated. Refer to Division 01 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review

C. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and ICC A117.1.

1.05 COORDINATION

A. Coordinate installation of exterior wall joint systems with roof expansion assemblies to ensure that wall transitions are watertight. Roof expansion assemblies are specified in Division 07.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
2. Mill Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

B. Elastomeric Seals: Preformed elastomeric membranes or extrusions to be installed in metal frames.

C. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.

D. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required rating period.

E. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.02 ARCHITECTURAL JOINT SYSTEMS, GENERAL

A. General: Provide architectural joint systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.

1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where joint changes direction or abuts other materials.
2. Include factory-fabricated closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.

B. Design architectural joint systems for the following size and movement characteristics:

1. Nominal Joint Width: As indicated on Drawings.
2. Movement Capability: Plus or minus 50 percent.
3. Type of Movement: Thermal.

2.03 ARCHITECTURAL JOINT SYSTEMS FOR BUILDING INTERIORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the products specified in individual subparagraphs below as basis-of-design products or a comparable product by one of the following:

1. Construction Specialties, Inc.

B. Floor-to-Floor Joint Systems:

1. Basis-of-Design Product: Construction Specialties, Inc. Model PCS-2G.
2. Type: Glide plate.
    a. Exposed Metal: Aluminum.
        1) Finish: Mill.
3. Cover-Plate Design: Serrated.
4. Attachment Method: Mechanical anchors
5. Load Capacity: Standard duty.

C. Acceptable Manufacturers:

1. Balco, Inc., Model RPA
2. MM Systems Corp., Model X-V

2.04 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine surfaces where architectural joint systems will be installed for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare substrates according to architectural joint system manufacturer's written instructions.

B. Repair concrete slabs using manufacturer's recommended repair grout of compressive strength adequate for anticipated structural loadings.

C. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

3.03 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing architectural joint assemblies and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install joint systems.

1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper joint installation and performance.
3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
4. Locate in continuous contact with adjacent surfaces.
5. Standard-Duty Systems: Shim to level where required. Support underside of frames continuously to prevent vertical deflection when in service.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

C. Terminate exposed ends of joint assemblies with field or factory-fabricated termination devices.

3.04 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION

SECTION 08 11 00

METAL DOORS AND FRAMES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes standard hollow metal doors, frames, sidelights and borrowed light frames.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Section 04 22 00 – Concrete Unit Masonry
2. Section 08 80 00 – Glazing.
3. Section 08 71 00 – Door Hardware
4. Section 09 91 00 – Painting: Field painting doors and frames.
5. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.02 REFERENCES

A. SDI standards:

1. SDI-108-18 Recommended Selection and Usage Guide for Standard Steel Doors
2. SDI-111-09 Recommended Details and Guidelines for Standard Steel Doors, Frames, and Accessories
3. SDI-112-08 Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
4. SDI-117-13 Manufacturing Tolerances for Standard Steel Doors and Frames
5. SDI-124-16 Maintenance of Standard Steel Doors and Frames

B. ANSI Standards:

1. ANSI/UL 10B-2020 Fire Tests of Door Assemblies
2. ANSI/UL 10C-2021 Positive Pressure Fire Tests of Door Assemblies
3. ANSI/UL 1784-2020 Air Leakage Test of Door Assemblies
4. ANSI/NFPA 80-2019 Fire Doors and Fire Windows
5. ANSI/NFPA 252-2017 Fire Tests of Door Assemblies
6. ANSI/SDI A250.3-2019 Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
7. ANSI/SDI A250.4-2018 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings
8. ANSI/SDI A250.6-2015 Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
9. ANSI/SDI A250. 8-2014 Specifications for Standard Steel Doors and Frames
10. ANSI/SDI A250.10-2020 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
11. ANSI/SDI A250.11-2012 Recommended Erection Instructions for Steel Frames (Formerly SDI-105)
12. ANSI A115.18 Hardware Preparation in Steel Doors and Steel Frames
13. ANSI/DHI A115.IG Installation Guide for Doors and Hardware

1.03 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.20 deg Btu/F x h x sq. ft. when tested according to ASTM C518.

1.04 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Show the following:

1. Elevations of each door and frame design.
2. For doors with thresholds, show coordination of threshold height and the threshold's integral seal with position of the bottom edge of the door for a proper closure an seal of the bottom of the opening.
3. Frame details for each frame type including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Details of conduit and preparations for power, signal, and control systems.
8. Coordination of glazing frames and stops with glass and glazing requirements.

C. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings.

1.05 QUALITY ASSURANCE

A. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

B. Provide doors and frames complying with ANSI/SDI 100 "Recommended Specifications for Standard Steel Doors and Frames" and as specified.

C. Doors shall be provided to conform with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local Regulations. These requirements supersede Technical Specifications in this Section.

D. Fire rated door and frame construction to conform to NFPA 80 for fire rated class indicated in the door schedule; and shall have been tested, listed and labeled in accordance with ASTM E152. Provide doors compatible with existing labeled frames, resulting in an approved, labeled assembly.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Inspect doors and frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect; otherwise, remove and replace damaged items as directed.

C. Doors and frames shall be stored vertically under cover. The units shall be placed on at least 4" high wood sills or in a manner that will prevent rust or damage. The use of non-vented plastic or canvas shelters that can create a humidity chamber shall be avoided.

D. A ¼ inch space between the doors shall be provided to promote air circulation. If the wrapper on the door becomes wet, it must be removed immediately.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Steelcraft, ALLEGION, Cincinnati, OH.

B. Acceptable Manufacturers: Subject to compliance with requirements, products of the following manufacturers are acceptable:

1. Ceco Door; ASSA ABLOY, Chicago, IL
2. Curries Company, ASSA ABLOY, Mason City, IA
3. Pioneer Industries, ASSA ABLOY, Carlstadt, NJ

4. Republic Doors and Frames, ALLEGION, McKenzie, TN

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

G. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

2.03 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B..

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches.
   c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
   d. Edge Construction: Model 2, Seamless.
   e. Core: Manufacturer's standard.
   f. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.

2. Frames:

   a. Materials:

      1) Openings Up To and Including 48-Inches: Uncoated steel sheet, minimum thickness of 0.053 inch.
      2) Openings More Than 48-Inches: Uncoated steel sheet, minimum thickness of 0.067 inch.

   b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Full profile welded.

2.04 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A..

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches.
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
   d. Edge Construction: Model 2, Seamless.
   e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.

f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
g. Core: Manufacturer's standard.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A60 coating.
b. Construction: Full profile welded.

2.05 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.06 FRAME ANCHORAGE

A. Floor Anchors:

1. At bottom of jamb use 0.053 inch thick steel clip angles welded to jamb and drilled to receive two 1/4 inch floor bolts.
2. Form jamb anchors of not less than 0.042 inch thick steel unless otherwise specified.
3. Where floor fills occur, provide extension type floor anchors to compensate for depth of fill.

B. Jamb Anchors:

1. Locate anchors on jambs near top and bottom of each frame, and at intermediate points not over 24 inches apart, except for fire rated frames space anchors as required by labeling authority.
2. Anchors set in masonry: Use adjustable anchors designed for friction fit against the frame and for extension into the masonry not less than 10 inches. Use one of following type:

a. Wire loop type of 3/16 inch diameter wire.
b. T-shape or strap and stirrup type of corrugated or perforated sheet steel.

3. Anchors for stud partitions: Either weld to frame or use lock-in snap-in type. Provide tabs for securing anchor to the sides of the studs.
4. Anchors for frames set in prepared openings:

a. Steel pipe spacers with 1/4 inch inside diameter welded to plate reinforcing at jamb stops or hat shaped formed strap spacers, 2 inches wide, welded to jamb near stop.
b. Drill jamb stop and strap spacers for 1/4 inch flat head bolts to pass thru frame and spacers.
c. Two piece frames: Subframe or rough buck drilled for 1/4 inch bolts.

5. Anchors for observation windows and other continuous frames set in stud partitions.

a. In addition to jamb anchors, weld clip anchors to sills and heads of continuous frames over 4 feet long.
b. Anchors spaced 24 inches on centers maximum.

6. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

2.07 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond dge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.08 FINISHES

A. Shop Painting:

1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before the application of the shop coat of paint.
2. Clean, treat, and paint exposed surfaces of fabricated hollow metal doors and frames, including galvanized surfaces plus back prime exterior hollow metal door frames.
3. Apply shop primer that complies with ANSI A250.10 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied topcoats. Apply primer immediately after surface preparation and pretreatment.
4. Apply shop coat of prime paint of not less than 1.0 mil without runs, smears, or bare spots ready to receive field applied paint.

B. Factory Priming for Field-Painted Finish: Apply shop primer that complies with ANSI A250.10 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied primer and topcoats. Apply shop primer immediately after surface preparation and pretreatment.

C. Field finishing of doors and frames is specified in Section 09 91 00 – Painting, and consists of primer plus two finish coats per the finish schedule.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Hollow Metal Frames: Install frames plumb, level, rigid and in true alignment as recommended in ANSI/SDI A250.11, “Recommended Erection Instructions for Steel Frames” and A115.IG, “Installation Guide for Doors and Hardware”. Frames shall be fastened to the adjacent structure so as to retain their position and stability.

1. Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.
2. In existing concrete or masonry construction, provide at least three completed opening anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.
3. In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
4. In-place concrete or masonry construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. Grout hollow metal frames in exterior openings, interior frames installed in masonry and concrete construction and elsewhere as indicated.
    a. Where grouting is required in masonry installations, frames shall be braced or fastened in such a way that will prevent the pressure of the grout from deforming the frame members. Grout shall be mixed to provide a 4 inch maximum slump consistency, hand troweled into place. Grout mixed to a thin “pumpable” consistency shall not be used.
    b. Place a temporary vertical brace in head frames for openings over 4 feet wide at the center to support frame head during installation until grouting has cured.
6. In-place gypsum board partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
8. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind door frames.
    a. At fire-protection-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable glazing stops located on secure side of opening.
    d. Install door silencers in frames.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
9. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
10. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 08 80 00 – Glazing and with hollow metal manufacturer's written instructions.

E. Installation of hardware items shall be in accordance with the hardware manufacturer's recommendations and templates. A115.IG, "Installation Guide for Doors and Hardware" and ANSI/SDI A250.6, "Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames" shall be consulted for other pertinent information.

3.02 FIELD QUALITY CONTROL

A. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, section 5.2
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, section 7.2.1.15.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

D. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.03 ADJUSTING AND CLEANING

A. Remove grout and other bonding material from hollow metal work immediately after installation.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes non-rated access doors and frames.

B. Related Sections:

1. Section 09 29 00 – Gypsum Board: Installation of access panels into drywall assemblies.
2. Section 09 30 13 – Tiling: Installation of access panels into tiled walls.

1.02 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit product data for each type of access door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.

C. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

D. Information and Review Submittals:

1. Product Data: Manufacturer's product data sheets, specifications and installation instructions.
2. Schedule: Submit Schedule of all access panels to be furnished hereunder, indicating locations for each size and type of access door.
    a. Ensure that all of the types/styles of panels and frames specified herein can be furnished by the manufacturer submitted.
    b. Prior to submitting schedule, coordinate with the work of Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating and Air Conditioning and Division 26 – Electrical and meet with the Architect to determine exact quantities and locations required for the installation of access panels.
3. Shop drawings: Large scale details of access doors, indicating all sizes, gages and thickness; provide complete installation details, coordinated to the specific receiving conditions.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Acudor Products Inc., Cedar Grove, NJ.
2. Karp Associates Inc., Maspeth, NY.
3. Nystrom Products Company, Minneapolis, MN.
4. Williams Brothers Corporation of America, Front Royal, VA.

B. Single Source: All work of this Section shall be produced by a single manufacturer, unless otherwise approved by the Architect.

2.02 ACCESS PANELS – FOR NON- RATED CONSTRUCTION

A. For non-rated wall and ceiling surfaces (service and non-public areas): Flush panel door type meeting the following requirements:

1. Frame type:
    a. For tiled walls: 16 gage Type 304 stainless steel flanged frame, with flange exposed to view 1 inch or less, equal to:

1) Acudor UF-5000 series.
2) Karp DSC-214SM series.
3) Nystrom NT series.
4) Williams WB-GP series.

b. For gypsum board walls and ceilings: 16 gage galvanized bonderized steel frame, with 22 gage galvanized steel drywall bead.

1) Acudor DW-5040 series.
2) Karp KDW series.
3) Nystrom NW series.
4) Williams WB-PL series.

2. Door: Flush panel door as follows:

a. Typical all wall types, except tile: 14 gage galvanized bonderized steel.
b. For tiled walls: 14 gage type 304 stainless steel.

3. Hinge:

a. Typical: Concealed spring hinge enabling door to open 175 degrees and permit removal of door from frame.
b. Panels greater than 24 by 36 inches: Flush continuous piano hinge with stainless steel pin.

4. Latching/Locking Device: Key operated cylinder lock

a. Provide 2 keys per lock; access door locks shall be master-keyed alike.

2.03 FABRICATION

A. General: Provide access door assemblies manufactured as integral units ready for installation.

B. Steel Access Doors: Fabricate units of continuous welded steel construction. Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. Provide special sized access doors where required or requested.

C. Frames:

1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame for steel frames.
2. Provide trimless carbon steel frames with drywall bead for installation in gypsum wallboard assembly, furnish perforated frames with drywall bead, securely attached to perimeter of frames, in size to suit thickness of gypsum panels indicated. Provide mounting holes in frames to attach frames to metal framing in drywall construction.

2.04 FACTORY FINISHING

A. Panel assemblies fabricated from stainless steel: Nº. 4 satin finish.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's instructions for installation of access doors. Coordinate installation with work of other trades.

B. Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

C. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

D. Install access doors flush with adjacent finish surfaces or recessed to receive finish material

E. Adjust doors and hardware after installation for proper operation.

F. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 32 13

SLIDING ALUMINUM FRAMED GLASS DOORS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Interior, manually operated, top-hung sliding aluminum framed glass doors

B. Related Sections:

1. Section 08 80 00 - Glazing

1.02 REFERENCES

A. ANSI – American National Standards Institute

1. ANSI 156.18 Materials and Finishes
2. ANSI A117.1 Specifications for making buildings and facilities usable by physically handicapped people.

B. BHMA – Builders Hardware Manufacturers Association

C. DHI – Door and Hardware Institute

D. NFPA – National Fire Protection Association

1. NFPA 80 – Fire Doors and Windows
2. NFPA 101 – Life Safety code
3. NFPA 105 – Smoke and Draft Control Door Assemblies
4. NFPA 252 – Fire Tests of Doors Assemblies

E. AWS – Architectural Woodwork Standards

1.03 ACTION SUBMITTALS

A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures

B. Product Data: Submit manufacturer's product data, including installation instructions.

C. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, components, hardware, finish, options, and accessories. Shop Drawings to show required blocking by others.

D. Samples: Submit manufacturer's samples of the following sliding door components:

1. Door veneer or laminate sample.
2. Aluminum Frame finish sample.

E. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

F. Warranty Documentation: Submit manufacturer's standard warranty.

G. Test Reports: Submit acoustical reports or UL1784 as applicable.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Installer experienced to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to product manufacturer.

B. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction, approving acceptable installer and approving application method.

1. Maintain within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Source Limitations: Obtain sliding aluminum-framed glass doors through one source from a single manufacturer.

D. Sliding Aluminum-Framed Glass Door Standard: Comply with provisions in AAMA/NWWDA 101/I.S.2 for standards of performance, materials, components, and fabrication unless more stringent requirements are indicated.

1. Provide AAMA-certified, sliding aluminum-framed glass doors with an attached label.

E. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201.

1. Subject to compliance with requirements, permanently mark safety glass with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

F. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, manufacturer's warranty requirements and to comply with requirements in 013100 - Project Management and Coordination.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Packing, shipping, Handling and Unloading: Deliver Materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful weather conditions.

D. Handle material and components to avoid damage. Protect Sliding Door material against damage from elements, construction activities and other hazards before, during and after installation of the Sliding Glass Doors.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify sliding aluminum-framed glass door openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating sliding aluminum-framed glass doors without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sliding aluminum-framed glass doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection.
b. Faulty operation of movable panels and hardware.
c. Deterioration of glazing and metal finishes.

2. Warranty Period:

a. Door: Five years from date of Substantial Completion.
b. Glazing: Five years from date of Substantial Completion.
c. Finish: Ten years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B 221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.

B. Hardware: Manufacturer's standard for operable panel partition and accessories; with decorative, protective finish.

2.02 MANUFACTURERS

A. Basis of Design: AD SYSTEMS, Everett, WA

2.03 SLIDING GLASS DOORS

A. Manufacturer:

1. Scheduled Manufacturer: OfficeSlide™ High Performance Barn (Sliding) Door System by AD Systems.

B. Operable Sliding Glass doors: Operable aluminum-framed glass door system, including panel, seals, suspension system, recessed floor track, and accessories.

C. Panel Operation: three sliding glass panels, – unless otherwise indicated.

1. Factory-Glazed Fabrication: Glaze operable glass panels in the factory where practical and possible for applications indicated. Comply with manufacturer's written requirements and with requirements in Section 08 80 00 - Glass and Glazing.

D. Glass: Specified in 08 80 00 – Glazing

E. Glazing: Manufacturer's standard vinyl gaskets.

F. Panel Frame Thickness: Nominal 1-1/2 inches.

G. Frame Profiles: Extruded aluminum frame “wrap” frame with integral vertical jamb (stile pocket).

1. Profile Dimensions:

a. [Standard Depth (IM-01) Mullion and Sill] (Option A in sample drawings)

H. Panel Construction: Manufacturer's standard glazed door panels, reinforced as required to support door panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate door panels so finished in-place is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

a. [Full Depth Mullion and Sill] (Option B in sample drawings)
b. [U-Channel Head & Sill] (Option C in sample drawings)
c. Vertical Mullions (if applicable): [vertical frames at joints] [no vertical frame, butt glazed]

I. Door Leaves: all Doors to be factory machined for hardware including pilot and function holes.

1. Aluminum Stile & Rail Door: Manufacturer’s standard 1-3/4 inch thick glazed doors with extruded-aluminum tubular stile and rail members. Welded and bolted corner connections.

a. 3-1/2 inch vertical stiles plus 1/2 inch stop.
b. 3-1/2 inch Horizontal stiles plus 1/2 inch stop
c. Optional: 10” bottom Rail.
d. Glazing: [monolithic clear tempered] [safety laminated glass] [sound enhanced laminated glass] [integral blinds] [other glass as specified by architect].

J. Door Components:

1. Single Top Track: AD Systems extruded aluminum track by AD Systems
2. Valances: Extruded aluminum with integral end caps
3. Top Rollers: tandem nylon roller sized to match door weight.

4. Concealed Floor Guide: Integral Jamb floor guide by AD Systems.
5. Soft-Closers: Soft-closing dampener mechanism at [one] [both] sides of door leaf
6. [Soft-Closer highly recommended at both sides of the door leaf]. Demonstrate closers as tested to 150k cycles.
7. Pull Handles:
    a. AD Systems Standard Ladder Pull: 16” long x 1” diameter. Finish: US32D Satin Stainless Steel.
    b. AD Systems Standard Straight Pull: 12” long x 1” diameter. Finish: US32D Satin Stainless Steel.
    c. Flush Pull and custom pull handle by request.

2.04 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes

2.05 SEALS

A. Manufacturer's standard pile weatherstrip seals.

1. Seals made from materials and in profiles that minimize sound leakage.
2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine wall openings to receive sliding doors for plumb, level, and square. Note: Finish door operation will be affected by out of tolerance framing.

B. Verify dimensions of wall openings.

C. Examine surfaces to receive top and bottom guide.

D. Notify Architect of conditions that would adversely affect installation or subsequent use of sliding doors.

E. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

A. Comply with manufacturer’s product installation data and recommendations for installation requirements of sliding door units, hardware, and other components in accordance with manufacturer’s warranty provisions.

B. Install sliding doors plumb, level, square, and in proper alignment to close against walls without gaps.

C. Install sliding doors to open and close smoothly.

D. Anchor sliding doors securely in place to supports. Required: Fire treated 2 x 6 blocking required full length of track.

3.03 ADJUSTING

A. Adjust sliding doors for proper operation in accordance with manufacturer’s instructions.

B. Adjust sliding doors to operate smoothly without binding.

C. Repair minor damages to finish in accordance with manufacturer’s instructions and as approved by Architect.

3.04 CLEANING

A. Clean aluminum surfaces immediately after installing sliding aluminum-framed glass doors. Avoid damaging protective coatings and finishes. Repair or replace damaged installed products Remove excess glazing and sealants, dirt, and other substances.

B. Clean glass of factory-glazed doors immediately after installing sliding aluminum-framed glass doors. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels from glass surfaces.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the Construction Period.

3.05 PROTECTION

A. Protect installed sliding doors from damage during construction. Remove and replace damaged sliding doors at no extra cost.

END OF SECTION

SECTION 08 36 13

SECTIONAL DOORS

1.01 SUMMARY

A. Section includes electrically operated sectional overhead doors.

B. Related Sections include the following:

1. Division 08 Section DOOR HARDWARE for lock cylinders and keying.
2. Division 09 Sections PAINTING for field applied paint finish.

1.02 DEFINITIONS

A. Operation Cycle: One cycle of a door is complete when it is moved from the closed position to the fully open position and returned to the closed position.

1.03 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide sectional overhead doors capable of withstanding the effects of gravity loads and the loads and stresses of the project without evidencing permanent deformation of door components:

B. Operation-Cycle Requirements: Provide sectional overhead door components and operators capable of operating for not less than 10,000 cycles.

1.04 SUBMITTALS

A. Qualification Data: For Installer

B. Maintenance and Operating Instructions: For doors and operating equipment.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain sectional overhead doors through one source from a single manufacturer.

1. Obtain operators and controls from sectional overhead door manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Steel Doors with Insulated Steel Panels:

a. Fimbel Door Corporation.
b. Haas Door; a Nofziger Company.
c. Overhead Door Corp.
d. Raynor.
e. Wayne-Dalton Corp.

2. Aluminum Doors with Insulated Panels:

a. Fimbel Door Corporation.
b. Haas Door; a Nofziger Company.

2.02 STEEL DOOR SECTIONS

A. Construct door sections including face sheets and frames from zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, G60 coating designation.

1. Minimum Base-Metal (Uncoated) Thickness for Section Faces: 0.033 inch.

B. Fabricate door panels from a single sheet to provide sections not more than 24 inches high and nominally 2 inches deep. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weathertight seal, with a reinforcing flange return.

1. For insulated doors, provide door sections with continuous thermal-break construction, separating faces of door.

C. Enclose open sections with channel end stiles formed from not less than 0.064-inch- thick galvanized steel sheet and weld end stiles to door section in place. Provide intermediate stiles formed from not less than 0.064-inch- thick galvanized steel sheet, cut to door section profile, and welded in place.

1. Stile Spacing: Not more than 48 inches apart.

D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized steel bars, struts, trusses, or strip steel, formed o depth and bolted or welded in place.

E. Provide reinforcement for hardware attachment.

F. Thermal Insulation: Insulate inner core of steel sections with door manufacturer's standard polyurethane insulation, foamed in place to completely fill inner core of section and pressure bonded to face sheets to prevent delamination under wind load, and with maximum flame spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84.

G. Enclose insulation completely within steel sections that incorporate the following inside facing material, with no exposed insulation material evident:

H. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.

I. Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean galvanized surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants.

a. Pretreat zinc-coated steel, after cleaning, with a conversion coating of type suited to organic coating applied over it.

2. Apply manufacturer's standard primer and finish coats to interior- and exterior-door faces after forming, according to coating manufacturer's written instructions for application, thermosetting, and minimum dry film thickness.

2.03 ALUMINUM DOOR SECTIONS

A. Construct door sections with extruded-aluminum shapes, complying with ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, with wall thickness not less than 0.065 inch for door section 1-3/4 inches deep. Panels shall include 1½” extruded polyurethane insulation foamed in place. Fabricate sections with stile and rail dimensions and profiles shown. Join stiles and rails by welding or with concealed, 1/4-inch- minimum diameter, aluminum or nonmagnetic stainless steel through bolts, full height of door section. Form meeting rails to provide a weathertight-seal joint. Provide reinforcement for hardware attachment.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

2.04 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Manufacturer's standard, galvanized steel track system, sized for door size and weight, designed for lift type indicated and clearances shown, and complying with ASTM A 653/A 653M for minimum G60 zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced at 2 inches apart for door drop safety device. Slope tracks at proper angle from vertical or design to ensure tight closure at jambs when door unit is closed. Weld or bolt to track supports.

B. Track Reinforcement and Supports: Galvanized steel track reinforcement and support members, complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.

1. Support and attach tracks to opening jambs with continuous angle welded to tracks and attached to wall. Support horizontal (ceiling) tracks with continuous angle welded to track and supported by laterally braced attachments to overhead structural members at curve and end of tracks.

a. Repair galvanized coating on tracks according to ASTM A 780.

C. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of overhead door.

1. Provide motor-operated doors with combination bottom weatherseal and sensor edge.
2. Provide continuous flexible seals at door jambs for a weathertight installation.

D. Windows: Type and size indicated and in arrangement shown. Set glazing in vinyl, rubber, or neoprene glazing channel for metal-framed doors as required. Provide removable stops of same material as door-section frames.

1. Clear Float Tempered Glass: 3 mm thick and complying with ASTM C 1036, Type I, Class 1, Quality Q3.

2.05 HARDWARE

A. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty galvanized steel hinges of not less than 0.0747-inch- thick, uncoated steel at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges where required, for doors exceeding 16 feet in width, unless otherwise recommended by door manufacturer.

C. Rollers: Heavy-duty rollers with steel ball bearings in casehardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- diameter roller tires for 3-inch- wide track and 2-inchdiameter roller tires for 2-inch- wide track.

1. Tire Material: Casehardened steel.

D. Push/Pull Handles: For push-up-operated or emergency-operated doors, provide galvanized steel lifting handles on each side of door.

E. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.

F. If door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.

2.06 COUNTERBALANCE MECHANISM

A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from oil-tempered-steel wire complying with ASTM A 229/A 229M, Class II, mounted on a cross-header tube or steel shaft. Connect to door with galvanized aircraft-type lift cables with cable safety factor of at least 5 to 1. Provide springs calibrated for a minimum of 10,000 cycles.

B. Cable Drums: Cast-aluminum or gray-iron casting cable drums grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of shaft. Provide one additional midpoint bracket for shafts up to 16 feet long and two additional brackets at one-third points to support shafts more than 16 feet long unless closer spacing is recommended by door manufacturer.

C. Cable Safety Device: Include a spring-loaded, steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either cable breaks.

D. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level shaft and prevent sag.

E. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.07 ELECTRIC DOOR OPERATORS

A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycle requirements specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

B. Comply with NFPA 70.

C. Disconnect Device: Hand-operated disconnect device or mechanism for automatically engaging chain-and-sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount disconnect device and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

D. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.

E. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70, Class 2 control circuit, maximum 24-V, ac or dc.

F. Door-Operator Type: Unit consisting of electric motor and the following:

1. Gear-head trolley type, with enclosed worm gear, running-in-oil, primary drive; chain and-sprocket secondary drive; and quick release for manual operation.

G. Electric Motors: High-starting torque, reversible, continuous-duty, Class A insulated, electric motors complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction from any position, at not less than 2/3 fps and not more than 1 fps, without exceeding nameplate ratings or service factor.

1. Type: Polyphase, medium-induction type.
2. Service Factor: Comply with NEMA MG 1, unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.

H. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."

1. Provide full-guarded, surface-mounted, heavy-duty-type interior unit with general purpose, NEMA ICS 6, Type 1 enclosure.
2. Provide full-guarded, standard-duty, surface-mounted, weatherproof-type exterior unit with NEMA ICS 6, Type 4 key-operated control station.

I. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.

1. Pressure-Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

J. Limit Switches: Adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General: Install door, track, and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's written instructions, and as specified.

B. Fasten vertical track assembly to framing, spaced not less than 24 inches apart. Hang horizontal track from structural overhead framing with angle or channel hangers fastened to framing by welding or bolting or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

3.02 ADJUSTING

A. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and with weathertight fit around entire perimeter.

B. Adjust belt-driven motors as follows:

1. Use adjustable motor-mounting bases for belt-driven motors.
2. Align pulleys and install belts.
3. Tension belt according to manufacturer's written instructions.

C. Touch-up Painting: Immediately after welding galvanized track-to-track supports, clean field welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780.

3.03 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional overhead doors.

END OF SECTION

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Aluminum swing doors at entrances, both exterior and interior openings, complete with thermal insulated glazing and tempered single pane as indicated on drawings.
2. Installation of door hardware in accordance with Section 08 71 00 – Door Hardware.

B. Related Sections:

1. Section 07 92 00 – Joint Sealants for system perimeter sealant.
2. Section 08 71 00 – Door Hardware for hardware to the extent not specified in this Section.
3. Section 08 80 00 – Glazing: Materials and installation.
4. Division 26: For rough-in for control wire and cable for low energy automatic door operators and security hardware.

1.02 SYSTEM DESCRIPTION

A. General: Provide aluminum storefront system capable of withstanding loads and thermal and structural movement requirements indicated without failure, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project. Failure includes the following:

1. Air infiltration and water penetration exceeding specified limits.
2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.

B. Glazing: Physically and thermally isolate glazing from framing members.

C. Thermally Broken Construction: Provide systems that isolate aluminum exposed to exterior from aluminum exposed to interior with a material of low thermal conductance.

D. Wind Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding wind-load design pressures calculated according to requirements of authorities having jurisdiction or the American Society of Civil Engineers' ASCE 7-10, "Minimum Design Loads for Buildings and Other Structures," 6.4.2, "Analytical Procedure," whichever are more stringent.

1. Structural Properties Wind Loads: Indicated in Structural General Notes on structural drawings.
2. Deflection of framing members in a direction normal to wall plane is limited to 1/175 of clear span or 3/4 inch, whichever is smaller, unless otherwise indicated.
3. Static-Pressure Test Performance: Provide storefront system that does not evidence material failures, structural distress, failure of operating components to function normally, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.

    a. Test Pressure: 150 percent of inward and outward wind-load design pressures.
    b. Duration: As required by design wind velocity; fastest 1 mile (1.609 km) of wind for relevant exposure category.

E. Dead Loads: Provide storefront-system members that do not deflect an amount which will reduce glazing bite below 75 percent of design dimension when carrying full dead load.

1. Provide a minimum 1/8-inch (3.18-mm) clearance between members and top of glazing or other fixed part immediately below.

F. Live Loads: Provide storefront system, including anchorage, that accommodate the supporting structures' deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.

G. Air Infiltration: Provide entrance and storefront systems with permanent resistance to air leakage through fixed glazing and frame areas of not more than 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft.

H. Water Penetration: Provide entrance and storefront systems that do not evidence water leakage through fixed glazing and frame areas when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward-acting wind-load design pressure as defined by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," but not less than 12 lbf/sq. ft. Water leakage is defined as follows:

1. Uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.

I. Thermal Movements: Provide storefront system, including anchorage, that accommodates thermal movements of systems and supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, and other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

J. Structural-Support Movement: Provide entrance and storefront systems that accommodate structural movements including, but not limited to, sway and deflection.

K. Condensation Resistance: Provide storefront systems with condensation resistance factor (CRF) of not less than 60 when tested according to AAMA 1503.1.

L. Thermal Conductance: Provide storefront systems with maximum U-values of not less than 0.46 Btu/hr/sq. ft./deg F when tested according to AAMA 1503.1.

M. Dimensional Tolerances: Provide entrance and storefront systems that accommodate dimensional tolerances of building frame and other adjacent construction.

1.03 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. Shop Drawings: Submit shop drawings for fabrication and installation of aluminum entrances and storefront systems and associated components of the work including the following:

1. Include fully dimensioned typical and special unit plans and elevations, sections at 1/2-inch scale and details at 3-inch scale or larger, and the following information:

a. Tolerances.
b. Profiles of members.
c. Anchorage system.
d. Connections and fasteners.
e. Provisions for expansion and contraction.
f. Flashings and drainage.
g. Finishes.
h. Glazing.
i. Interface with building construction.

2. Include setting drawings, templates, and directions for the installation of anchor bolts and other anchorages installed as a unit of work under other sections.

D. Samples: Submit material and finish samples required for the work:

1. Samples showing type and color of painted aluminum finish, on 12 inch long sections of extrusions and on 6 inch square sheets.

1.04 INFORMATIONAL SUBMITTALS

A. Maintenance Data: Furnish written instructions to Owner describing recommended materials and methods for proper maintenance of storefront system.

B. Test Reports: Furnish manufacturer's written test reports substantiating products meet or exceed performance requirements specified herein.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Provide aluminum storefront framing systems manufactured by a single firm, providing single-source responsibility for all components of the work.

B. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing entrance and storefront systems similar to those required for this Project and who is acceptable to manufacturer.

1. Engineering Responsibility: Prepare data for storefront systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

C. Standard of Quality:

1. The specifications and drawings show and define the essential minimum requirements for quality of materials, construction, finish and overall installation.
2. Minor variations in construction techniques between manufacturers will be permitted, providing specified standards of materials, design, function, dimension, configuration, strength, quality and performance are met.

1.06 DELIVERY, STORAGE AND HANDLING

A. Pack, deliver, handle, store and protect materials from damage in accordance with AAMA Curtain Wall #10. "Care and Handling of Architectural Aluminum" recommendations.

1. Remove paper type wrappings when unloading.
2. Store materials inside the buildings whenever possible in clean, dry ventilated areas free of dust or corrosive fumes.
3. Stack members vertically or on edge, shim between components to provide water drainage and ventilation. Protect with adequate coverings, placed to provide water drainage and ventilation. Protect with adequate coverings, placed to provide adequate air circulation.
4. During installation, protect materials from lime, mortar, run-off from concrete and copper, weld splatter, acids, roofing materials, solvents and abrasive cleaner.
5. Do not incorporate damaged materials into the work.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. General: Coordinate approved hardware items with the finish hardware supplier. Contractor will not be entitled to any claims for failure to do this required coordination.

C. Receive and install all required finish hardware for aluminum and glass doors. Reinforce doors and frames where mortised for hardware with backing plates as required to ensure adequate strength of the connection. Obtain hardware templates from finish hardware supplier.

1.08 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of storefront system that fails in materials or installation within the specified warranty period. Failures include, but are not limited to, the following:

1. Structural failures including, but not limited to, excessive deflection.
2. Failure of system to meet performance requirements.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Water leakage through fixed glazing and frame areas.

C. Warranty Periods:

1. Labor and Material: Two (2) years from date of Substantial Completion.
2. For metal finishes: Ten (10) years from Substantial Completion.
3. For glass refer to Section 08 80 00 – Glazing

PART 2 – PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Basis of Design: Contract Documents are based on products and systems specified to establish a standard of quality. Other named acceptable manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

1. Basis of Design Products:. Kawneer Co., Inc

a. Storefront System: Trifab Versa Glaze 451 Framing System, 2"X4 1/2" Front Set/

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include those indicated below.

1. YKK AP America Inc
2. Oldcastle Building Envelope.
3. EFCO Corporation

2.02 MATERIALS AND ACCESSORIES

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).
5. Welding Rods and Bare Electrodes: AWS A5.10.

B. Steel Reinforcement: Complying with ASTM A 36 (ASTM A 36M) for structural shapes, plates, and bars; ASTM A 611 for cold-rolled sheet and strip; or ASTM A 570 (ASTM A 570M) for hot-rolled sheet and strip.

C. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.

D. Secondary Sealant: For use as weatherseal, compatible with structural silicone sealant and other system components with which it comes in contact, and that accommodates a 50 percent increase or decrease in joint width at the time of application when measured according to ASTM C 719.

E. Glazing as specified in Section 08 80 00 – Glazing.

F. Sealants and joint fillers for joints at perimeter of entrance and storefront systems as specified in Section 07 92 00 – Joint Sealants.

G. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

H. Fasteners: Aluminum, non-magnetic stainless steel, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum components.

1. Do not use exposed fasteners except where unavoidable for application of hardware. Match finish of adjoining metal.
2. Provide Phillips flat-head machine screws for exposed fasteners.

I. Concealed Flashing: Dead-soft stainless steel, 26 gage minimum, or extruded aluminum, 0.062 inch minimum, of an alloy and type selected by manufacturer for compatibility with other components.

J. Trim and Accessories: As required to complete the work, finish to match aluminum entrances and storefront finish. Finish after fabrication, unfinished exposed edges at holes and trim terminations are not acceptable.

K. Brackets and Reinforcements: Manufacturer's high-strength aluminum units whenever possible; otherwise, non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A123.

L. Masonry Inserts: Cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A123.

2.03 STOREFRONT FRAMING SYSTEM

A. Thermal Barrier (Trifab™ VG 451T):

1. Thermal Break with a 1/4" (6.4 mm) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.

a. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposes shall be stainless steel.

D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action

E. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

F. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

2.04 ENTRANCE DOORS

A. Basis-of-Design Product: Kawneer swing entrance as follows, or a comparable product by one of the following:

1. YKK AP Series 35D medium stile door, “.
2. EFCO Corporation Series "D-502" wide stile thermal door, "403T" center set, thermal storefront, "402" non-thermal storefront,.
3. Oldcastle Building Envelope Series "500T" wide stile thermal door, "3000T" center set, thermal storefront, "3000" center set, non-thermal storefront,.

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 2-1/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated, and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Medium stile; 3-1/2-inch nominal width.

3. Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
    a. Provide nonremovable glazing stops on outside of door.
4. Door Finish: High-Performance Organic Finish (Three-Coat Fluoropolymer):

C. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.

1. Nominal Size: As indicated on Drawings.
2. Exterior Framing Construction: Thermally improved.
3. Finish: Match door finish.

D. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

F. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    a. Sheet and Plate: ASTM B209.
    b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
    c. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
    d. Structural Profiles: ASTM B308/B308M.
2. Steel Reinforcement:
    a. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
    b. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
    c. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
3. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

G. Door Hardware: As specified in Section 08 71 00 – Door Hardware except as follows:

1. Weather Stripping: Manufacturer's standard replaceable components.
    a. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
    b. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.05 FABRICATION

A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

1. Fabricate components that, when assembled, have the following characteristics:
2. Profiles that are sharp, straight, and free of defects or deformations.
3. Accurately fitted joints with ends coped or mitered.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

B. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

C. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

D. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

F. Prefabrication: Complete fabrication, assembly, finishing, and other work before shipment to project site. Disassemble components only as necessary for shipment and installation.

1. Do not drill and tap for surface-mounted hardware items until time of installation at project site.
2. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work in manner which prevents damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.

G. Welding: Comply with AWS recommendations to avoid discoloration; grind exposed welds smooth and restore mechanical finish.

H. Reinforcing: Install reinforcing as necessary for performance requirements; separate dissimilar metals with bituminous paint or other separator which will prevent corrosion.

I. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.

J. Fasteners: Conceal fasteners wherever possible.

2.06 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish Application:

1. Apply high performance organic coatings to all exposed exterior surfaces of glazed aluminum storefront components.
2. Adhesion and Compatibility Testing: Test samples of aluminum coatings on aluminum will be required for compatibility and adhesion testing of all sealants proposed for use on framing components. Refer to Section 07 92 00 ‘Joint Sealants’.
3. Appearance of Finished Work: During production, maintain large size color range samples for use in comparing against production material. Variations in appearance of abutting or adjacent pieces are acceptable if they are within the range of approved samples. Noticeable variations in the same piece are not acceptable.

C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

D. High-Performance Organic Coating Finish: AA-C12C42R1x and the following:

1. Polyvinylidene fluoride finish coating containing not less than 70% of "Kynar 500" or "Hylar 5000" fluorocarbon resin specially formulated for spray application to extrusions and preformed aluminum metal shapes. Remove die markings, scratches, abrasions, dents and other blemishes before applying finish. Coating films shall be uniform and visibly free from flow lines, streaks, blisters, sags or other surface imperfections in the dry-film state on all surfaces.
2. Thickness:
    a. Fluoropolymer 2-Coat Coating System: Minimum 1.2 mil total dry film thickness (0.25 mil primer +/- 0.05 mil and 1.0 mil topcoat).
    b. Coating Performance Criteria: Meets or exceeding AAMA 2605.
3. Color: Custom color as selected by the Architect.

PART 3 – EXECUTION

3.01 PREPARATION

A. Field Measurements: Take field measurements and coordinate the preparation of shop drawings and fabrication, to ensure proper fitting of work.

B. Examine substrates, supporting structure and installation conditions. Do not proceed with erection until satisfactory conditions have been corrected.

C. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install the aluminum entrance and storefront systems in accordance with manufacturer's instructions and final shop drawings.

B. Do not install component parts which are observed to be defective, including warped, bowed, dented, abraded or broken. Remove and replace members which have been damaged during installation or thereafter before time of acceptance.

C. Do not cut or trim component parts during erection, in a manner which would damage finish, decrease strength, or result in a visual imperfection or a failure in performance of the work.

D. Apply a bituminous coating or other permanent separator on concealed contact surfaces of dissimilar materials, before assembly or installation to prevent corrosive or electrolytic action.

E. Install component parts plumb, level, and true to line, without warp of framing members. Anchor securely in place, separating aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials. Use erection equipment which will not mar or stain finished surfaces and will not damage component parts.

F. Anchor component parts securely in place by bolting, or other permanent mechanical attachment system, which will comply with performance requirements and permit movement as required.

G. Install glazing as specified in Section 08 80 00 – Glazing.

3.03 ADJUSTING, CLEANING AND PROTECTION

A. Adjust operating hardware to function properly, without binding, and to prevent tight fit and contact points and weatherstripping.

B. Clean completed system, inside and out, promptly after erection and installation of glazing. Remove excess glazing and joint sealants, dirt, and other substances from aluminum surfaces.

C. Institute protective measures and other precautions required to assure that aluminum entrances will be without damage or deterioration, other than normal weathering, at time of acceptance.

D. Immediately before acceptance of the work, clean the aluminum entrance and storefront system thoroughly, inside and out. Prepare a "Cleaning and Maintenance Manual" listing types of cleaning compound, cleaning methods, sealants and glazing materials used for cleaning, repair and maintenance of work and turn over to Owner upon completion of the work.

END OF SECTION

SECTION 08 42 29

SLIDING AUTOMATIC ENTRANCES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes exterior and interior, sliding, power-operated automatic entrances.

B. Related Requirements:

1. Section 03 30 00 – Cast-in-Place Concrete forming recesses in concrete for recessed thresholds.

1.02 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.

C. IBC: International Building Code.

D. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.

E. For automatic door terminology, refer to BHMA A156.10 for definitions of terms.

1.03 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed sliding tracks and recessed thresholds that control automatic entrances. Concrete, reinforcement, and formwork requirements are specified elsewhere.

B. Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing automatic entrances.

C. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.

D. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control system.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For automatic entrances.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Indicate locations of activation and safety devices.
5. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

C. Samples for Initial Selection: For units with factory-applied metal-clad finishes.

1. Include Samples of hardware and accessories involving color or finish selection.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Delegated-Design Submittal: For automatic entrances.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Product Certificates: For each type of automatic entrance. Include emergency-exit features of automatic entrances serving as a required means of egress.

C. Product Test Reports: For each type of automatic entrance, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For automatic entrances, safety devices, and control systems to include in operation and maintenance manuals.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer with company certificate issued by AAADM indicating that manufacturer has a Certified Inspector on staff.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

C. Certified Inspector Qualifications: Certified by AAADM.

1.09 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.

1) Lateral deflection of glass lite edges in excess of 1/175 of their length or 3/4 inch (75 mm), whichever is less.

b. Excessive air leakage
c. Faulty operation of operators, controls, and hardware.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 AUTOMATIC ENTRANCE ASSEMBLIES

A. Source Limitations: Obtain sliding folding and swinging automatic entrances from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Power-Operated Door Standard: BHMA A156.10.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01400 "Quality Requirements," to design automatic entrances.

B. Structural Performance: Automatic entrances shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Wind Loads: As indicated on Structural drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. Operating Temperature Range: Automatic entrances shall operate within minus 20 to plus 122 deg F.

E. Thermal Transmittance (U-factor): Swinging doors and framing areas shall have U-factor of not more than 0.70 Btu/sq. ft. x h x deg F.

F. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. of fixed entrance-system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..

G. Opening Force:

1. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.
2. Breakaway Device for Power-Operated Doors: Not more than 50 lbf required for a breakaway door or panel to open.

H. Entrapment-Prevention Force:

1. Power-Operated Sliding Doors: Not more than 30 lbf required to prevent stopped door from closing.

2.03 SLIDING AUTOMATIC ENTRANCES

A. General: Provide manufacturer's standard automatic entrances including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, controls, and accessories required for a complete installation.

B. Sliding Automatic Entrance:

1. Biparting-Sliding Units:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Stanley Access Technologies (ALLEGION)
b. Horton Automatics; a division of Overhead Door Corporation.
c. Record-USA.

3. Configuration: Biparting-sliding doors with two sliding leaves sidelites on each side.

a. Traffic Pattern: Two way.
b. Emergency Breakaway Capability: As indicated on Drawings.
c. Mounting: Between jambs.

4. Operator Features:

    a. Power opening and closing.
    b. Drive System: Chain or belt.
    c. Adjustable opening and closing speeds.
    d. Adjustable hold-open time between zero and 30 seconds.
    e. Obstruction recycle.
    f. On-off/hold-open switch to control electric power to operator, key operated.

5. Sliding-Door Carrier Assemblies and Overhead Roller Tracks: Carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.

    a. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

6. Sliding-Door Threshold: Threshold members and bottom-guide-track system with stainless-steel, ball-bearing-center roller wheels.

    a. Configuration:

        1) Exterior Vestibule Doors: Recessed-Saddle-type threshold across door opening and inverted, roller surface-mounted, pin recessed, pin-guide track system at sidelites. Top surface of threshold coplanar with adjacent pedestrian pavement surfaces.
        2) Interior Vestibule Doors: No threshold across door opening with guide mechanism same as “Exterior” above.

7. Controls: Activation and safety devices according to BHMA standards.

    a. Activation Device: Motion sensor mounted on each side of door header to detect pedestrians in activating zone and to open door.
    b. Safety Device: Presence sensor mounted on each side of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.
    c. Sidelite Safety Device: Presence sensor, mounted above each sidelite on side of door opening through which doors travel, to detect obstructions and to prevent door from opening.
    d. Opening-Width Control: Two-position switch that in the normal position allows sliding doors to travel to full opening width and in the alternate position reduces opening to a selected partial opening width.

2.04 ENTRANCE COMPONENTS

A. Framing Members: Extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.

1. Nominal Size: 1-3/4 by 4-1/2 inches.
2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.

B. Stile and Rail Doors: 1-3/4-inch- thick, glazed doors with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.

1. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets. Bottom Rail 10-inch nominal height.
2. Stile Design: Medium stile, 3-1/2-inch nominal width.
3. Rail Design:

    a. Top Rail: 5-inch nominal height.
    b. Bottom Rail 10-inch nominal height.

C. Sidelite(s): 1-3/4-inch- deep sidelite(s) with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members matching door design.

1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
2. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

D. Headers: Fabricated from minimum 0.125-inch- thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

1. Mounting: Concealed, with one side of header flush with framing.
2. Capacity: Capable of supporting doors up to 175 lb per leaf over spans up to 14 feet without intermediate supports.

a. Provide sag rods for spans exceeding 14 feet.

E. Brackets and Reinforcements: High-strength aluminum with nonstaining, nonferrous shims for aligning system components.

F. Signage: As required by cited BHMA standard.

1. Application Process: Silk-screened Insert requirement.

2.05 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B 221.
2. Sheet: ASTM B 209.

B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

C. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 316.

D. Stainless-Steel Tubing: ASTM A 554, Grade MT 316.

E. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316, stretcher-leveled standard of flatness, in entrance manufacturer's standard thickness.

F. Glazing: As specified in Section 08 80 00 – Glazing.

G. Sealants and Joint Fillers: As specified in Section 07 92 00 – Joint Sealants.

H. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107/C 1107M; of consistency suitable for application.

I. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

J. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.06 DOOR OPERATORS AND CONTROLS

A. General: Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.

1. Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
2. Electromechanical Operators: Concealed, self-contained, overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation with power off.

C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by its plastic housing; adjustable to provide detection-field sizes and functions required by BHMA A156.10.

1. Provide capability for switching between bidirectional and unidirectional detection.

D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.

F. Push-Plate Switch: Momentary-contact door-control switch with flat push-plate actuator with contrasting-colored, engraved message.

1. Configuration: Square push plate with 4-by-4-inch junction box.

a. Mounting: Recess mounted, semiflush in wall.

2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
3. Message: International symbol of accessibility and "Push to Open."

G. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.07 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish unless otherwise indicated.

B. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door shall be as stipulated in "Performance Requirements" Article. Interrupt powered operation of door operator while in breakaway mode.

1. Include emergency-exit features of automatic entrances serving as a required means of egress, that allow egress without any special knowledge when doors are locked to stop entry into the building.

C. Automatic Locking: Electrically controlled device mounted in header that automatically locks sliding door against sliding when in closed position. Provide fail secure operation if power fails with panic hardware that allows emergency egress.

1. Include concealed, vertical-rod exit devices, UL 305, with latching into threshold and overhead carrier assembly and released by full-width panic bar; and that prevent emergency breakaway doors from swinging unless released to permit emergency egress.
2. Include locking devices for sidelites to prevent manual break out.

D. Weather Stripping: Replaceable components.

1. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.08 FABRICATION

A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

1. Form aluminum shapes before finishing.
2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing.

a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
b. Reinforce members as required to receive fastener threads.

4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

1. Fabricate tubular and channel frame assemblies with welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
3. Form profiles that are sharp, straight, and free of defects or deformations.
4. Provide components with concealed fasteners and anchor and connection devices.
5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
6. Fabricate exterior components to drain condensation and water passing joints within system to the exterior.
7. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
8. Allow for thermal expansion of exterior units.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors and breakaway sidelites.

G. Controls:

1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
2. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:

a. Top Beam: 48 inches.
b. Bottom Beam: 24 inches.

2.09 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic entrance installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install automatic entrances according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.

1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Level recesses for recessed thresholds using nonshrink grout.

C. Door Operators: Connect door operators to electrical power distribution system.

D. Access-Control Devices: Connect access-control devices to access-control system as specified in Division 16.

E. Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Guide Rails: Install rails according to BHMA A156.10, including Appendix A, and manufacturer's written instructions unless otherwise indicated.

G. Glazing: Install glazing as specified in Section 08 80 00 – Glazing.

H. Sealants: Comply with requirements specified in Section 07920 "Joint Sealants" to provide weathertight installation.

1. Set thresholds, bottom-guide-track system, framing members and flashings in full sealant bed.
2. Seal perimeter of framing members with sealant.

I. Signage: Apply signage on both sides of each door and breakaway sidelite as required by cited BHMA standard for direction of pedestrian travel.

J. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.03 FIELD QUALITY CONTROL

A. Certified Inspector: Owner will engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Automatic entrances will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.04 ADJUSTING

A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

1. Adjust exterior doors for weathertight closure.

B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to [four] visits to Project during other-than-normal occupancy hours for this purpose.

3.05 CLEANING

A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.

1. Comply with requirements in Section 08800 "Glazing" for cleaning and maintaining glass.

3.06 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 24 months' full maintenance by skilled employees of automatic entrance Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper automatic entrance operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
2. Perform maintenance, including emergency callback service, during normal working hours.
3. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION

SECTION 08 44 13

GLAZED ALUMINUM CURTAIN WALLS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes glazed aluminum curtain wall assemblies for the project. The aluminum curtain wall assemblies work includes the following:

1. Exterior curtainwall

B. Systems consist of the following:

1. Curtain wall framing.
2. Aluminum trim, snap in sealant stops, flashings, parapet copings, and similar items in conjunction with aluminum curtain wall assemblies.
3. Internal steel and aluminum reinforcements.
4. Internal and perimeter weeps, vents and gasketing systems.
5. Anchors, embedments, shims, fasteners, inserts, expansion devices, accessories, support brackets, attachments, and grout.

C. Related Sections:

1. Section 07 62 00 – Sheet Metal Flashing: Stainless steel flashing installed as part of the curtain wall system.
2. Section 07 92 00 – Joint Sealants for installation of joint sealants installed with glazed aluminum curtain-wall systems and for sealants to the extent not specified in this Section.
3. Section 08 41 13 – Aluminum Framed Entrances and Storefronts.
4. Section 08 80 00 – Glazing for glass and glazing of aluminum curtainwall systems.

1.02 REFERENCE STANDARDS

A. The following Standards are incorporated into these Specifications. Unless otherwise noted, comply with the current version of these Standards.

B. American Architectural Manufacturers Association (AAMA):

1. Aluminum Curtain Wall Manual No. 10, “Care and Handling of Architectural Aluminum from Shop to Site”
2. Curtain Wall Design Guide Manual, AAMA CW-DG-1, and the AAMA Metal Curtain Wall Manual
3. 501 – Methods of Tests for Exterior Walls
4. 501.2 – Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems
5. 501.3 – Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing by Uniform Air Pressure Difference
6. 502 – Voluntary Specification for Field Testing of Windows and Sliding Glass Doors
7. 806-1 – Specification for Bonding Type Back Bedding Glazing Tapes for Use with Architectural Aluminum
8. 1503.1 – Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections

C. American Society for Testing and Materials (ASTM):

1. C920 – Specification for Elastomeric Sealant Joints
2. E283 – Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen
3. E330 – Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
4. E331 – Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
5. E783 – Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors

6. E1105 – Field Determination of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference
7. E448 – Standard Practice for Scleroscope Hardness Testing of Metallic Materials
8. E774 – Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units National Association of Architectural Metal Manufacturer's (NAAMM) Metal Finishes Manual for Architectural and Metal Product

D. Glass Association of American (GANA):

1. Glazing Manual and Sealant Manual

E. The Aluminum Association:

1. Specification for Aluminum Structures – Allowable Stress Design Specification and Commentary

F. American Society of Civil Engineers:

1. ASCE-7 – Minimum Design Loads for Buildings and Other Structures

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Design and provide means to anchor the curtain wall system to the building structure. Curtain wall fabricator/installer shall provide all engineering required to fabricate, attach, and install curtain wall system to edge of slab or other construction. Connections shall be designed to deliver vertical curtain wall loads as gravity load direct to beam without introducing torsion. Minimize out-of-plane wind loading by engaging both top flange and web of spandrels.

B. General: Provide glazed aluminum curtain wall systems meeting or exceeding the following performance requirements:

1. Structural Properties Wind Loads:

a. Exterior Walls: The glazed aluminum curtain wall work, including glass, shall be designed, fabricated and installed to withstand the maximum inward and outward wind pressures as required by the building code per requirements in the Structural General Notes:

C. General Performance: Comply with performance requirements specified, as determined by testing manufacturer's standard of glazed curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed curtain walls shall withstand movements of supporting structure indicated on Drawings including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
c. Deflection exceeding specified limits.
d. Glass breakage.
e. Water leakage.
f. Air leakage exceeding specified maximum value.
g. Condensation formation on interior surfaces at thermal design conditions.
h. Other structural failure.
i. Noise or vibration created by wind and thermal and structural movements.
j. Loosening or weakening of fasteners, attachments, and other components
k. Failure of operating units.
l. Sealant failure (adhesive or cohesive).

D. Structural Loads:

1. Wind Loads: As indicated on drawings.
2. Seismic Loads: As indicated on drawings.

E. Structural-Test Performance: Provide glazed curtain walls tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Uniform Load: A static air design load of 40 psf shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member at design load. At structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur:

G. Windborne-Debris-Impact-Resistance Performance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone applicable to the Project's locale.

1. Large-Missile Test: For glazed openings located within 30 feet of grade.

H. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 20 lbf/sq. ft.

I. Water Penetration under Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.

1. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.

J. Thermal Movements: Design and detail wall and its components to permit thermal movement without causing buckling; glass and glazing system damage or failure; sealant failure; excess stress on framing, anchors and fasteners; reduction of performance or other detrimental effects. Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
2. Test Interior Ambient-Air Temperature: 75 deg F.

K. Seismic:

1. When tested to AAMA 501.4, system must meet design displacement (elastic) of 0.010 times the story height and ultimate displacement (inelastic) of 1.5 times the design displacement.
2. When tested to AAMA 501.6, system must meet dynamic seismic drift causing glass fallout (ΔFallout) of 4" or 0.0300 times the story height.

L. Energy Performance: Glazed curtain walls shall have certified and labeled energy performance ratings according to NFRC.

1. Thermal Transmittance (U-Factor): Fixed glazing and framing assemblies shall have U-factor of not more than 0.36 Btu/sq. ft. x h x deg F as determined according to AAMA 1503.
2. Average Solar Transmittance: Provide glazed aluminum curtain wall systems with average solar heat gain coefficient of not more than 0.50 when modeled in accordance with NFRC 200 or physically tested in accordance with NFRC 201.
3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area as determined according to ASTM E 283 at a minimum static- air-pressure differential of 6.24 lbf/sq. ft.
4. Condensation Resistance: Condensation Resistance: Provide curtainwall system with condensation resistance factor (CRF) of not less than 75 (Frame) and 75 (Glass) with 1/2 inch warm edge spacer and argon fill gas, when tested according to AAMA 1503.1.
    a. Design the wall and its components to not develop any visible interior condensation on framing members or glazing.
    b. Provide independent laboratory test reports based on AAMA 1503, confirming wall system performance to at least the above criteria.

c. If independent laboratory test reports are unavailable to verify thermal performance, provide computer analysis using Therm 5 and Windows 5 software as developed by Lawrence Berkeley National Laboratory. Include in the analysis at least all principle mullions for sill, jamb, and head conditions for vision lights and spandrel areas.

1.04 PRECONSTRUCTION TESTING

A. Preconstruction Sealant Testing: Perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will come in contact with sealants and each condition.

1. Test a minimum five production-run samples each of metal, glazing, and other material.
2. Prepare samples using techniques and primers required for installed assemblies.
3. Perform tests under environmental conditions that duplicate those under which assemblies will be installed.
4. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.

1.05 ACTION SUBMITTALS

A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: For glazed curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed curtain walls, showing the following:

a. Details of all shapes and conditions, including intersections.
b. Joinery, including concealed welds.
c. Reinforcing.
d. Anchorage systems.
e. Integration with surrounding construction (coordinated with related trades).
f. Flashing
g. Thermal breaks.
h. Glazing and reglazing details.
i. Frame seals.
j. Water drainage details and flow diagrams; location of weeps..
k. Provisions for frame adjustability without compromising frame perimeter seals (includes inner and outer seals).
l. Provisions for expansion and contraction.
m. Isometric (three-dimensional) details of complex conditions, such as gutter splices, gutter transitions, gutter end dams, termination of sill flashing conditions, etc.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1. Submit 3 sets of labeled Samples of the following.

a. Typical extrusions and formed shapes, 12 inches long, with specified color and finish.
b. Include 2 or more Samples in each set, indicating limits of variation, if any, in color and finish.
c. Typical sheet, plate and panel, 6 inches square, with specified color and finish. Include 2 or more Samples in each set, indicating limits of variation, if any, in color and finish.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.

2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

G. Delegated-Design Submittal: For glazed curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and testing agency.

B. Welding certificates.

C. Energy-Performance Certificates: For glazed curtain walls, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy-performance values for each glazed curtain wall.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed curtain walls, indicating compliance with performance requirements.

E. Preconstruction Test Reports: For glazed curtain walls and elastomeric glazing sealants, written on sealant manufacturer’s official letterhead.

1. Submit statement for structural glazing sealants, written on sealant manufacturer's official letterhead and signed by the responsible representative, indicating that structural sealants have been tested prior to installation and conform to the requirements of the Contract Documents and the following:

a. The structural sealant meets ASTM C1184.
b. The structural sealant is compatible with specified sealant backing and spacer materials as deter- mined by ASTM C1087.
c. The structural sealant is compatible with and does not adhere to specified bond breaker and spacer materials as determined by ASTM C1087.
d. The structural sealant is compatible with the insulating glass unit edge seal.
e. The structural sealant is compatible with and has been tested for adequate adhesion to each respective substrate.
f. The details of construction have been reviewed and are approved for use with the structural seal- ant.
g. The design stress of the sealant due to the application of the primary forces does not exceed 138 kPa (20 psi).

2. Submit test reports, as partial fulfillment of these requirements, from the manufacturers or an independent laboratory. Testing of structural sealants shall comply with ASTM C1021. Schedule sufficient time for the conducting of testing, certification of results and submission, to not cause a delay in the progress of the Work.

F. Maintenance Data: For glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for post installation-phase quality-control program.

G. Warranties: Sample of special warranties.

1.07 QUALITY ASSURANCE

A. Manufacturer's Qualifications: A minimum of 10 years of successful experience in the manufacture of similar glass-and-metal curtain wall systems.

B. Installer Qualifications: Minimum 5-7 years of successful experience in the installation of systems similar to those required. Capable of assuming engineering responsibility and performing Work of this Section and who is acceptable to manufacturer.

C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field-testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of glazed curtain walls.

F. Energy-Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

1. Provide NFRC-certified, glazed curtain walls with an attached label.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Coordination." Prior to the start of the curtain wall work, and at the Contractor's direction, meet at the site and review the construction schedule, availability of materials, installers personnel qualifications, equipment and facilities needed to make progress and avoid delays, installation procedures, testing, inspecting, and certification procedures, and coordination with other work. Meeting shall include Construction Manager, Contractor, curtain wall installer, manufacturer's representative, as well as any other subcontractors or material technical service representatives whose work, or products, must be coordinated with the curtain wall work.

H. Field Measurements: Verify actual locations of structural supports for glazed curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

1.08 COORDINATION

A. Field Measurements: If possible, verify actual locations of structural supports for glazed-aluminum curtain wall systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating glazed aluminum curtain wall systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions and tolerances. The Contractor assumes full responsibility for establishing existing dimensions and meeting required tolerances and sightlines.
2. Notify Architect in writing if field measurements of structure cannot be performed prior to fabrication.
3. Notify Architect in writing if field measurements of existing construction indicate that the system will exceed any of the tolerances prescribed in "Erection Tolerances."
4. The proper alignment of the new curtain wall members is critical to the air and watertightness of the system. The Contractor bears full responsibility for performing a detailed field survey prior to issuing shop drawings and beginning fabrication. Should the Contractor need to perform remedial work to the building structure as a result of inadequate field measurements, the Owner shall not bear any additional costs.

B. Work in conjunction with the other trades employed on the project by promptly completing the work of this Section as required to meet the project schedule and so as not to impede other trades.

1. Coordinate the work of this Section with other trades so that the intent of the Drawings and Specifications is carried out.
2. Coordinate with other trades to maximize efficient use of scaffolding and staging.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Handle and protect materials in transit and stored materials from damage due to exposure to moisture, excess heat, sparks, flame, or any other cause. Replace damaged materials.

B. The Contractor is responsible for protecting all materials and equipment stored on the site.

C. All materials to be new. Place materials on pallets. Use waterproof and fireproof canvas tarpaulins (not polyethylene) to cover all stored materials top to bottom.

D. Protect all materials in original, unopened, labeled containers, and packaging and in compliance with manufacturer's directions. Comply with manufacturer's recommendations for minimum and maximum time and temperature limits for storage.

E. Promptly remove from the site all materials rejected by the Architect during transportation, storage, handling, and installation.

F. Do not stockpile materials or equipment to overload any building or site component.

G. General: Conform to the handling standards of the AAMA Aluminum Curtain Wall Manual #10, "Care and Handling of Architectural Aluminum from Shop to Site" except where more-stringent requirements are specified herein.

H. Crate curtain wall framing and trim to avoid racking, twisting, or denting. Package components for transit sufficiently to avoid any damage to finish.

I. Protect liquid components (including sealants) and all other materials from damage due to freezing or other damage due to extreme temperatures.

J. Store rolled goods on ends only. Discard rolls that have been flattened, creased, or otherwise damaged. Unroll sheets and allow them to relax prior to use.

K. Do not dilute primers, roofing cements, adhesives, coatings, or sealants. Keep containers closed, except when removing materials. Do not use equipment with remains of previous bitumens other than asphalt.

L. Dispose of debris as required by state and local ordinances.

M. Do not allow wrappers, packaging, or other miscellaneous materials to be included in the system.

1.10 WARRANTY

A. Special Assembly Warranty: Standard form in which Installer agrees to repair or replace components of glazed curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection. Failure according to that specified in "Performance Requirements."
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Basis of Design: Contract Documents are based on products and systems specified to establish a standard of quality. Other named acceptable manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

1. Basis of Design:

a. Kawneer 1600 Wall System 2 Curtainwall

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include those indicated below.

1. Oldcastle Inc..
2. YKK AP America Inc.

2.02 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.03 FRAMING MATERIALS

A. Framing Members: Manufacturer's standard formed- or extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Glazing System: 2 sided captured
2. Glazing Plane: Front.

B. Doors: Comply with Division 08 Section “Aluminum-Framed Entrances and Storefronts”

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. No exposed fastenings will be permitted in aluminum work, unless otherwise specified or indicated.

    a. In certain locations where it is impossible or highly impractical, or in locations where exposed but hidden from view, consideration will be given to exposed fastenings where such fastenings are Phillips, flat head, or countersunk machine screws matching the finish of the adjacent wall system member.

D. Anchors: Three-way adjustable anchors, with minimum adjustment of 1 inch, that accommodate fabrication and installation tolerances in material and finish and are compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials or Dead-soft, 0.018-inch-thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.

F. Framing Sealants: Manufacturer's standard sealants with VOC content of 250g/L or less when calculated according to 40 CFR 59, Subpart D (EPA method 24).

2.04 GLAZING SYSTEMS

A. Glazing and glazing gaskets: Comply with Section 08 80 00 – Glazing.

1. 1600 System 2 Wall™ Curtain Wall System: Outside glazed pressure plate format with 1 inch glazed insulating glass units.

B. Glazing Gaskets, Spacers, Setting Blocks, Sealant Backings, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types compatible with sealants and suitable for joint movement and assembly performance requirements.

C. Glazing Sealants: For glazed curtain walls, as recommended by manufacturer for joint type, and as follows:

1. Structural Sealant: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.

   a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Color: As selected by Architect from manufacturer's full range.

2. Weatherseal Sealant: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and glazed curtain-wall manufacturers for this use.

   a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Color: Matching structural sealant.

2.05 ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

B. Cleaning Agent and Cloth: As recommended by structural-sealant manufacturer.

2.06 FABRICATION

A. General: Fabricate the glazed aluminum curtain walls to the designs, shapes, and sizes shown using the materials specified and shown to produce assemblies that meet or exceed the performance requirements. To the greatest extent possible complete fabrication, assembly, finishing, hardware applications and other work before shipment to Project site.

B. Form or extrude aluminum shapes before finishing.

C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

D. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
6. Provisions for field replacement of glazing from exterior. Include accommodations for using temporary support device (dutchman) to retain glazing in place while sealant cures.
7. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed curtain wall to exterior.

E. Shop Assembly: As far as practicable, all fitting and assembly work shall be done in a fabrication shop.

1. Framing members attaching curtain wall components to building supports shall provide for 3-way adjustment to accommodate fabrication and construction tolerances, and allow for thermal and building movements.

2. Provide vents, weepholes and internal water passages in the glazing framing recesses as recommended by the respective glass and framing manufacturers to conduct infiltrating water to the exterior, and to avoid condensation at glass spandrel unit air spaces. Provide weep baffles secured to inside of frame behind vents and weepholes.
3. Rigidly secure nonmovement joints.
4. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
5. Preparation includes, but is not limited to, cleaning and priming surfaces.
6. Seal joints watertight unless otherwise indicated.
7. Install glazing to comply with requirements in Section 08 80 00 – Glazing.

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

G. Trim and Sills:

1. Provide extruded aluminum trim, factory welded and ground smooth at corners and intersections.
2. Provide extruded aluminum sill extensions in profiles shown, with upturned end dams.
3. Caulk return legs shall be incorporated in panning die. Drive-on type caulk returns will not be acceptable.
4. Brake metal shapes will not be acceptable.
5. Minimum wall thickness shall be 0.050 inches.

2.07 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish Application:

1. Apply high performance organic coatings to all exposed exterior surfaces of glazed aluminum curtain wall components. Apply thermosetting acrylic enamel coatings to all exposed interior surfaces of glazed aluminum curtain wall components.
2. Adhesion and Compatibility Testing: Test samples of aluminum coatings on aluminum will be required for compatibility and adhesion testing of all sealants proposed for use on framing components. Refer to Section 07 92 00 – ‘Joint Sealants.
3. Appearance of Finished Work: During production, maintain large size color range samples for use in comparing against production material. Variations in appearance of abutting or adjacent pieces are acceptable if they are within the range of approved samples. Noticeable variations in the same piece are not acceptable.

C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

D. High-Performance Organic Coating Finish: AA-C12C42R1x and the following:

1. Polyvinylidene fluoride finish coating containing not less than 70% of "Kynar 500" or "Hylar 5000" fluorocarbon resin specially formulated for spray application to extrusions and preformed aluminum metal shapes. Remove die markings, scratches, abrasions, dents and other blemishes before applying finish. Coating films shall be uniform and visibly free from flow lines, streaks, blisters, sags or other surface imperfections in the dry-film state on all surfaces.
2. Thickness:
    a. Fluoropolymer 2-Coat Coating System: Minimum 1.2 mil total dry film thickness (0.25 mil primer +/- 0.05 mil and 1.0 mil topcoat).
    b. Coating Performance Criteria: Meets or exceeding AAMA 2605.
3. Color: Will be chosen by Architect from full range of coating industry colors and color densities including premium metallics for this type of finish, and will not be limited to this manufacturers’ published color charts.

2.08 COATINGS FOR CONCEALED METAL SURFACES

A. A. General: The following protective coatings shall be applied to surfaces of metals which are to be concealed in the construction:

1. Coating for Carbon Steel: Hot dip galvanized, complying with ASTM A 123.

2. Coating for Aluminum, and Carbon Steel: Where aluminum or carbon steel surfaces are to be in contact with each other or in contact with dissimilar materials such as masonry or concrete, and where hot dip galvanizing of carbon steel is incompatible with component parts because of galvanic action or component fabrication tolerances provide one of the following:

    a. Bituminous Paint: Cold-applied, non-sagging, bituminous paint complying with ASTM D 1187. Apply in two coats for an overall minimum dry film thickness of 25 mils.
    b. Zinc Rich Primer: Organic zinc-rich primer, complying with SSPC-Paint 20.

2.09 SOURCE QUALITY CONTROL

A. Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 – EXECUTION

3.01 PREPARATION

A. Coordinate glazed aluminum curtain wall work with the work of other Sections and provide items to be placed during the installation of other work at the proper time to avoid delays in the work.

B. Place such items, including concealed overhead framing, accurately in relation to the final location of glazed aluminum curtain wall components.

3.02 EXAMINATION

A. Examine the substrates, adjoining construction, and conditions under which the Work is to be installed. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Before beginning installation of the glazed aluminum curtain wall work examine all parts of the existing building structural frame and the existing building cladding indicated to support the glazed aluminum curtain wall work. Notify Contractor in writing, of any dimensions, or conditions, found which will prevent the proper execution of the glazed aluminum curtain wall work, including specified tolerances. Use Contractor's offset lines and bench marks as basis of measurements.

3.03 INSTALLATION

A. Comply with AAMA guide specification for window walls, and install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

B. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmoving joints.
5. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and impediments to movement of joints.
6. Perform field welding under the same requirements specified for shop welding.
7. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
8. Thoroughly clean welds and adjoining burned areas on primed surfaces and then paint the areas with priming paint of type used for shop coats, or zinc rich paint for galvanized steel.
9. Seal joints watertight unless otherwise indicated.

C. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed curtain walls to exterior.

E. Install components plumb and true in alignment with established lines and grades.

F. Install glazing as specified in Section 08 80 00 – Glazing. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

G. Pressure Plate Framing: Install glazing in accordance with Section 08 80 00, using exterior dry glazing method.

H. Perform no glazing prior to written certification of adhesion and compatibility test results, review and written approval of glazing details by glass and sealant manufacturers and acceptance of written quality assurance program.

I. Install weatherseal sealant according to Section 07 92 00 – Joint Sealants and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.04 ERECTION TOLERANCES

A. The glazed aluminum curtain wall systems shall be fabricated and erected to accommodate the dimensional tolerances of the structural frame and surrounding cladding while providing the following as installed tolerances.

1. Variation from theoretical calculated position as located in plan or elevation in relation to established floors lines, column lines and other fixed elements of the structure, including variations from plumb, level, straight and member size: +/- 1/4-inch max in any 20’-0” run, column-to-column bay, or floor-to-floor height.
2. Alignment: Where surfaces abut in line, and meet at corners, limit offset from true alignment to 1/32 inch.
3. Variation from angle, or plumb, shown: +/- 1/8-inch max in any 10’-0” run or story height, non-cumulative.
4. Variation from slope, or level, shown: +/- 1/8-inch max in any 20’-0” run or column-to-column bay, non-cumulative.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of representative areas of captured glazed curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.

1. Water Infiltration Tests:

a. Conduct tests in accordance with ASTM E 1105.
b. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 psf (383 Pa).

C. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections. Correct all deficiencies observed as a result of this test and retest. For each unsuccessful field test, another similar sample installation area shall be selected and tested.

D. Prepare test and inspection reports.

3.06 PROTECTION AND CLEANING

A. Protect building, new construction, and existing construction scheduled to remain from all weather and damage. Replace all material damaged due to water infiltration, weather, or other causes at no additional cost.

B. Protect materials against damage and contamination. Clean surfaces as required to remove corrosive substances and other substances that may affect the appearance or operation of the system, during and at the conclusion of construction. Remove all evidence of repair and cleaning.

C. Periodically remove from the site debris, excess materials and unused tools and equipment resulting from this work. At conclusion of construction, leave premises in clean condition.

END OF SECTION

CML BARNETT BRANCH LIBRARY ADDITION/RENOVATION
3434 East Livingston Avenue
Columbus, OH 43227

SECTION 08 71 00

DOOR HARDWARE

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:

    a. "Metal Doors and Frames"
    b. "Flush Wood Doors"
    c. "Stile and Rail Wood Doors"
    d. "Interior Aluminum Doors and Frames"
    e. "Aluminum-Framed Entrances and Storefronts"
    f. "Stainless Steel Doors and Frames"
    g. "Special Function Doors"
    h. "Entrances"

6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies

5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:

   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

   a. Wiring Diagrams: For power, signal, and control wiring and including:

      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

   a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:

   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
   b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
   c. Indicate complete designations of each item required for each opening, include:

      1) Door Index: door number, heading number, and Architect's hardware set number.
      2) Quantity, type, style, function, size, and finish of each hardware item.
      3) Name and manufacturer of each item.
      4) Fastenings and other pertinent information.
      5) Location of each hardware set cross-referenced to indications on Drawings.
      6) Explanation of all abbreviations, symbols, and codes contained in schedule.
      7) Mounting locations for hardware.
      8) Door and frame sizes and materials.

9) Degree of door swing and handing.
10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:

a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:

a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Final approved hardware schedule edited to reflect conditions as installed.
d. Final keying schedule
e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:

a. Fire door assemblies, in compliance with NFPA 80.
b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project’s vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.

3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
    a. For door hardware: DHI certified AHC or DHC.
    b. Can provide installation and technical data to Architect and other related subcontractors.
    c. Can inspect and verify components are in working order upon completion of installation.
    d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:
1. Fire-Rated Door Openings:
    a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
    b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
2. Smoke and Draft Control Door Assemblies:
    a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
    b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
3. Electrified Door Hardware
    a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
4. Accessibility Requirements:
    a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings
1. Keying Conference
    a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
        1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
        2) Preliminary key system schematic diagram.
        3) Requirements for key control system.
        4) Requirements for access control.
        5) Address for delivery of keys.
2. Pre-installation Conference
    a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    b. Inspect and discuss preparatory work performed by other trades.
    c. Inspect and discuss electrical roughing-in for electrified door hardware.
    d. Review sequence of operation for each type of electrified door hardware.
    e. Review required testing, inspecting, and certifying procedures.
    f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
    a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    a. Mechanical Warranty
        1) Locks
            a) 3 years
        2) Exit Devices
            a) 3 years
        3) Closers
            a) 30 years
    b. Electrical Warranty
        1) Locks

a) 1 year

2) Exit Devices

a) 1 year

3) Closers

a) 2 years

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Stile and Rail Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.

3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

   a. Ives 5BB series

2. Acceptable Manufacturers and Products:

   a. Hager BB1191/1279 series
   b. McKinney TB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:

   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:

   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:

   a. Ives

2. Acceptable Manufacturers:

   a. Select
   b. Roton

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.

3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:

   a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:

   a. Securitron CEPT-10
   b. Security Door Controls PTM

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

   a. Schlage L9000 series

2. Acceptable Manufacturers and Products:

   a. No Substitute

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
7. Provide motor based electrified locksets that comply with the following requirements:

   a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
   b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case.

c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
e. Connections – provide quick-connect Molex system standard.

8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

2.07 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. Von Duprin 98/35A series

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.08 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. Von Duprin 99/33A series

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.09 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

   a. Schlage/Von Duprin PS900 Series

2. Acceptable Manufacturers and Products:

   a. No Substitute

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:

   a. 12/24 VDC Output, field selectable.
   b. Class 2 Rated power limited output.
   c. Universal 120-240 VAC input.
   d. Low voltage DC, regulated and filtered.
   e. Polarized connector for distribution boards.
   f. Fused primary input.
   g. AC input and DC output monitoring circuit w/LED indicators.
   h. Cover mounted AC Input indication.
   i. Tested and certified to meet UL294.
   j. NEMA 1 enclosure.
   k. Hinged cover w/lock down screws.
   l. High voltage protective cover.

2.10 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:

a. Medeco

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.11 KEYING

A. Scheduled System:

1. Existing non-factory registered system:

a. Provide cylinders/cores keyed into Owner's existing keying system managed by Owner's locksmith, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Permanent Keying:

a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

1) Master Keying system as directed by the Owner.

b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.

c. Provide keys with the following features:

1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
2) Patent Protection: Keys and blanks protected by one or more utility patent(s).

d. Identification:

1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
2) Identification stamping provisions must be approved by the Architect and Owner.
3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

e. Quantity: Furnish in the following quantities.

1) Change (Day) Keys: 3 per cylinder/core.
2) Master Keys: 6.

2.12 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. LCN 4040XP series

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.13 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.14 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.

2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.15 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:

   a. Glynn-Johnson

2. Acceptable Manufacturers:

   a. Rixson
   b. Sargent

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

2.16 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:

   a. Ives

2. Acceptable Manufacturers:

   a. Burns
   b. Trimco

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.17 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:

   a. Zero International

2. Acceptable Manufacturers:

   a. Reese
   b. Legacy

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.18 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:

   a. Ives

2. Acceptable Manufacturers:

   a. Burns
   b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.19 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:

   a. Schlage

2. Acceptable Manufacturers:

   a. GE-Interlogix
   b. Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.20 BARN DOOR HARDWARE

A. Manufacturers:

1. Scheduled Manufacturer:

   a. Schlage

2. Acceptable Manufacturers:

   a. Brio
   b. KN Crowder

B. Requirements:

1. Provide complete sets of sliding door hardware as recommended by manufacturer for door type and weight.

   a. Include track, channels, brackets, hangers, fasteners, guides, pulls, stops, and other hardware as required for complete installation.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

L. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

O. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

R. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

100656 OPT0345691 Version 1

Hardware Group No. DD01

For use on Door #(s):
CONFERENCE
ROOM

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 M52A	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SILENCER	SR64	GRY	IVE

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Hardware Group No. DD02

For use on Door #(s):
MOTHERS ROOM
PUBLIC UNISEX TOILET

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK	L9492LEU M52A RX DM	626	SCH
1	EA	CYLINDER	AS REQUIRED	626	MED
1	EA	EXTERIOR INDICATOR - OCCUPIED/VACANT	L283-414	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	MULTITECH READER	MTB11/MTB15 - BY ACCESS CONTROL PROVIDER	BLK	SCE
1	EA	DOOR CONTACT	679 SERIES	BLK	SCE
1	EA	POWER SUPPLY	PS902	LGR	SCE

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER MOMENTARILY UNLOCKS OUTSIDE LEVER ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.

THROWING DEADBOLT CHANGES EXTERIOR INDICATOR FROM "VACANT" TO "OCCUPIED" AND DISABLES EXTERIOR READER.

Hardware Group No. DD03

For use on Door #(s):
STAFF TOILET

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK W/ INDICATOR	L9040 M52A L283-722	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

Hardware Group No. DD04

For use on Door #(s):
OFFICE

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L M52A	626	SCH
1	EA	CYLINDER	AS REQUIRED	626	MED
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

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Hardware Group No. DD05

For use on Door #(s):
RESTROOM
CHASE

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080L M52A	626	SCH
1	EA	CYLINDER	AS REQUIRED	626	MED
1	EA	OH STOP	100S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. DD06

For use on Door #(s):
ELECTRICAL IT JANITORIAL MECHANICAL STORAGE TYPICAL ACCESS CONTROL DOOR

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK	L9092LEU M52A RX	626	SCH
1	EA	CYLINDER	AS REQUIRED	626	MED
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	MULTITECH READER	MTB11/MTB15 - BY ACCESS CONTROL PROVIDER	BLK	SCE
1	EA	DOOR CONTACT	679 SERIES	BLK	SCE
1	EA	POWER SUPPLY	PS902	LGR	SCE

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER MOMENTARILY UNLOCKS OUTSIDE LEVER ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.

Hardware Group No. DD07

For use on Door #(s):
MULTI-PURPOSE/LARGE MEETING ROOM

Provide each SGL door(s) with the following:

4	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	LD-99-L-M52	626	VON
1	EA		RIM CYLINDER AS REQ'D	626	MED
1	EA	OH STOP & HOLDER	100H	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

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Hardware Group No. DD08

For use on Door #(s):
STAIRWELL

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-99-L-BE-F-M52-ALK	626	VON
1	EA	CYLINDER	AS REQUIRED	626	MED
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	MULTITECH READER	MTB11/MTB15 - BY ACCESS CONTROL PROVIDER	BLK	SCE
1	EA	POWER SUPPLY	PS902	LGR	SCE

WHEN TOUCHBAR OF EXIT DEVICE IS DEPRESSED, AN INTERNAL HORN SOUNDS INDICATING UNAUTHORIZED USE OF THE OPENING. ALARM CAN BE ARMED OR DISARMED BY KEYED CYLINDER.

PRESENTING VALID CREDENTIAL TO READER MOMENTARILY DISABLES ALARM.

Hardware Group No. DD09

For use on Door #(s):
EXTERIOR -
ACCESS
CONTROL

Provide each SGL door(s) with the following:

1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-QEL-99-NL-F	626	VON
1	EA	CYLINDER	AS REQUIRED	626	MED
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A	A	ZER
1	EA	MULTITECH READER	MTB11/MTB15 - BY ACCESS CONTROL PROVIDER	BLK	SCE
1	EA	DOOR CONTACT	679 SERIES	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	LGR	SCE

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER MOMENTARILY RETRACTS PANIC DEVICE LATCH ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.

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Hardware Group No. DD10

For use on Door #(s):
EXTERIOR -
ALARMED

Provide each SGL door(s) with the following:

1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-33A-EO-ALK	626	VON
1	EA	CYLINDER	AS REQUIRED	626	MED
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A	A	ZER
1	EA	DOOR CONTACT	679 SERIES	BLK	SCE
1	EA	POWER SUPPLY	PS902	LGR	SCE

PERIMETER SEALS BY ALUMINUM DOOR SUPPLIER

WHEN TOUCHBAR OF EXIT DEVICE IS DEPRESSED, AN INTERNAL HORN SOUNDS INDICATING UNAUTHORIZED USE OF THE OPENING. ALARM CAN BE ARMED OR DISARMED BY KEYED CYLINDER.

Hardware Group No. DD11

For use on Door #(s):
EXTERIOR -
STAIRWELL
(EXIT ONLY)

Provide each SGL door(s) with the following:

1	EA	CONT. HINGE	112XY	628	IVE
1	EA	FIRE EXIT HARDWARE	99-EO-F	626	VON
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A	A	ZER
1	EA	DOOR CONTACT	679 SERIES	BLK	SCE

EXIT ONLY

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes glass and glazing for the following applications, including those specified in other Sections where glazing requirements are specified by reference to this Section.

1. Doors and entrances glazing.
2. Curtainwall glazing
3. Interior glazing

B. Related Sections:

1. Section 08 11 00 – Metal Doors and Frames
2. Section 08 44 13 – Glazed Aluminum Curtain Walls

1.02 DEFINITIONS

A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.

B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

C. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

D. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.03 DESIGN REQUIREMENTS

A. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, and wind load and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.

1. Normal thermal movement is defined as that resulting from an ambient temperature range of 120 degrees F and from a consequent temperature range with glass and glass framing members of 180 degrees F.

B. Glass Design: Provide glass lites in the thickness and strengths (annealed or heat-treated) to meet or exceed the following criteria based on analysis of Project loads and in-service conditions.

1. Minimum glass thickness of lites composed of annealed or heat-treated glass are selected so the worst-case probability of failure does not exceed the following:

a. Eight (8) lites per 1000 for lites set vertically or not over 15 degrees off vertical and under wind action.
b. One (1) lite per 1000 for lites set over 15 degrees off vertical and under action of wind or snow.
c. Specified Design Wind Loads: As indicated on the Structural Drawings
d. Specified Design Snow Loads: As indicated on the Structural Drawings, but not less than snow loads applicable to Project, required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7, "Snow Loads.
e. Minimum Glass Thickness for Exterior Lites: Not less than 6mm

f. Thickness of Tinted and Heat-Absorbing glass: Provide the same thickness of each tint color indicated throughout Project.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. Center-of-glass U-values: NFRC 100 methodology using LBL-35298 WINDOW 5.2 computer program, expressed as BTU/sq ft x h x deg F (W/sq. m x K).
2. Center-of-glass solar heat gain coefficient: NFRC 200 methodology using LBL-35298 WINDOW 5.2 computer program
3. Solar Optical Properties: NFRC 300.

1.04 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

a. Specified Design Wind Loads: As indicated.
b. Minimum Glass Thickness for Exterior Lites: Not less than 1/4-inch.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 1/4-inch thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units with lites 1/4-inch thick and a nominal 1/2-inch wide interspace.
4. Center-of-Glass U-Values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program, expressed as Btu/sq. ft. x h x degrees F.
5. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program.
6. Solar Optical Properties: NFRC 300.

1.05 ACTION SUBMITTALS

A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: For each glass product and glazing material indicated.

C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. Samples: Submit 12-inch square samples of each type of glass indicated except for clear monolithic glass products, and 12-inch long samples of each color required (except black) for each type of sealant or gasket exposed to view.

E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

F. Product Test Reports: From a qualified testing agency indicating the following products comply with requirements, based on comprehensive testing of current products:

1. Insulating glass.

G. Warranties: Special warranties specified in this Section.

1.06 QUALITY ASSURANCE

A. Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section or in referenced standards.

1. NGA Publications:

a. GANA Glazing Manual (2023)
b. Laminated Glazing Reference Manual (2019)

B. Safety Glazing Standard: Provide type of products which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials.

1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

C. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).

D. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component pane of units with appropriate certification label of Insulating Glass Certification Council (IGCC).

E. To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and conditions of glass indicated and composed of primary glass obtained from a single source for each type and class required.

F. Preconstruction Compatibility and Adhesion Testing: Submit samples of all glass, gaskets, glazing accessories and glass framing members proposed for use in contact with, or proximity of, glazing sealants, to sealant manufacturer for compatibility and adhesion testing in accordance with sealant manufacturer's standard testing methods and the following requirements:

1. Submit each type and finish of glass framing member and of each type, class, kind, condition and form (monolithic, laminated, insulating units) of glass for adhesion testing and one sample of substrates (gaskets, setting blocks and spacers) for compatibility testing.
2. Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the work.
3. Investigate materials failing compatibility or adhesion tests and obtain sealant manufacturer's written recommendations for corrective measure, including use of specially formulated primers.

G. Installation: Performed only by experienced glaziers.

H. Mockups: Before glazing, build mockups for each glass product indicated below to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build mockups with the following kinds of glass to match glazing systems required for Project, including typical lite size, framing systems, and glazing methods:

a. Heat-strengthened coated glass.
b. Fully tempered glass.
c. Laminated glass.

3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect’s approval of mockups before starting fabrication.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed.
7. Approved mockups may become part of the completed Work if undisturbed at time of Contract Completion.

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 13 – Project Coordination.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Protect glass and glazing materials during delivery, storage, and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, and from other causes.

1. Handle and install glass in accordance with guidelines set forth in the NGA GANA Glazing Manual.

B. Deliver, store and handle glazing materials in accordance with manufacturer's recommendations to prevent damage and deterioration.

C. Deliver glass with manufacturer's labels intact. Do not remove labels until glass has been installed.

D. Deliver glazing compounds and sealants in manufacturer's unopened labeled containers.

1.08 PROJECT CONDITIONS

A. Field verify measurements and conditions of installation.

B. Examine all details. Provide proper fitting to details indicated.

C. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 degrees F (4.4 degrees C).

D. Protect work from damage during and after installation until project acceptance.

1.09 WARRANTY

A. Glass Installation: Submit installer's written warranty agreeing to repair or replace glass and glazing which fails to remain weathertight within five years of the date of acceptance of the work. warranty shall include sealants within the installation.

B. Manufacturer’s Special Warranty on Laminated Glass: Written warranty, made out to Owner and signed by laminated-glass manufacturer agreeing to furnish replacements for laminated-glass units that deteriorate as defined in “Definitions” Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Five years from date of Contract Completion.

C. Manufacturer’s Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed b0y insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units that deteriorate as defined in “Definitions” Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Contract Completion.

PART 2 – PRODUCTS

2.01 ACCEPTABLE GLASS MANUFACTURERS

A. Primary Glass; provide products from one of the following:

1. Viracon, Owatonna, MN
2. PPG Industries, Pittsburgh, PA
3. Guardian Industries, Carleton, MI
4. Pilkington North America, Toledo, OH
5. AGC, Kingsport, TN

2.02 GLASS PRODUCT STANDARDS

A. General: Unless indicated otherwise, reference numbers used throughout this Specification Section are from ASTM C 1036 and C 1048. When the end product involves one or more categories, both, the primary glass specifications and the specifications of the additional features or construction shall be met.

2.03 PRIMARY FLOAT GLASS

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); class as indicated in schedules at the end of Part 3.

2.04 HEAT-TREATED FLOAT GLASS

A. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated in schedules at the end of Part 3.

1. Kind heat-strengthened (HS)
2. Kind fully tempered (FT)

B. Heat-treated flat glass by horizontal (roller hearth) process with inherent roller wave distortion parallel to the bottom edge of the glass as installed

1. Maximum peak to valley roller wave tolerance is 0.003 inches (0.08mm) in the central area, and 0.008 inches (0.20mm) within 10.5 inches (267mm) of the leading and trailing edge.
2. Maximum bow and warp 1/32 inch per linear foot.
3. Upon request, provide proof of the glass meeting this standard.

C. Fabrication Process: By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturer’s option, except provide horizontal process where indicated as tongless or free of tong marks.

2.05 LAMINATED GLASS

A. Laminated Glass: Comply with ASTM C 1172 for kinds of laminated glass indicated and other requirements specified, including those in the Laminated-Glass Schedule at the end of Part 3.

B. Interlayer: Interlayer material as indicated below, clear or in colors, and of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.

1. Interlayer Material: Polyvinyl butyral sheets.

C. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets as follows:

1. Laminate lites with polyvinyl butyral interlayer in autoclave with heat plus pressure.

2.06 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Spacer: Aluminum with mill or clear anodic finish.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

B. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Insulating-Glass Schedule at the end of Part 3 are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

C. Sealing System: Dual seal, with primary and secondary sealants as follows:

1. Manufacturer's standard sealants.

D. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:

1. Aluminum with clear-anodized finish. Verify color with Architect.
2. Desiccant: Molecular sieve or silica gel, or blend of both.

3. Corner Construction: Manufacturer's standard corner construction.

2.07 EXTERIOR INSULATED VISION-GLASS UNITS

A. Low-Emissivity Coating: Low-emissivity coated glass produced by sputter coating technology applied in a vacuum chamber. Coating shall be applied to the #2 surface. Low-emissivity coated glass shall meet the following performance values; values listed have been based on Viracon (Basis of Design) VE1-2M (clear outboard and inboard glass) as indicated below.

B. Procedures as determined by Architect's approval, meeting both performance and aesthetic values.

C. Basis of Design Vision Glass: Low-e coated, clear insulating glass
Viracon VE1-2M

1. Overall unit Thickness: 1 inch; unit makeup indicated in Glazing Schedule.
2. uV transmittance: 0 percent
3. Visible Light Transmittance: 70 percent
4. Winter Nighttime U-Factor: 0.29 Btu/(hr x sq ft x ºF)
5. Summer Daytime U-Factor: 0.27 Btu/(hr x sq ft x ºF)
6. Reflectance (Exterior): 11 percent
7. Reflectance (Interior): 12 percent
8. Shading Coefficient: 0.45
9. Solar Heat Gain Coefficient: 0.39 maximum
10. LSG: 1.84
11. Provide safety glazing labeling.

D. Vitro Architectural Glass Solarban 60.

1. Overall unit Thickness: 1 inch; unit makeup indicated in Glazing Schedule.
2. Visible Light Transmittance: 70 percent.
3. Winter Nighttime U-Factor): 0.29.
4. Reflectance (Exterior): 11 percent.
5. Shading Coefficient: 0.44.
6. Solar Heat Gain Coefficient: 0.38.

E. Guardian Industries SN-68.

1. Overall unit Thickness: 1 inch; unit makeup indicated in Glazing Schedule.
2. Visible Light Transmittance: 68 percent.
3. Winter Nighttime U-Factor: 0.29.
4. Reflectance (Exterior): 10 percent.
5. Shading Coefficient: 0.43.
6. Solar Heat Gain Coefficient: 0.37.

2.08 INTERIOR GLASS

A. Interior Glass Types:

1. Interior Glass Type: Minimum 6 mm thick clear, tempered safety glass.

2.09 GLAZING MATERIALS AND ACCESSORIES

A. Provide products of type indicated and complying with the following requirements:

1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
2. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.
3. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C920 requirements, including those for Type, Grade, Class and uses.

B. Glazing Sealants and Compounds:

1. Provide glazing sealants of color indicated, when not indicated as selected by Architect from manufacturer's standard colors. Comply with manufacturer's recommendations for selection of hardness. Select materials and variations or modifications for compatibility with surfaces contacted in the installation.
2. Exterior Glazing: One part silicone rubber glazing sealant, complying with ASTM C920, non-sag. Provide acid type recommended by manufacturer where only non-porous bond surfaces are contacted, provide non-acid type recommended by manufacturer where one or more porous bond surfaces are contacted.
3. Interior Glazing: Butyl rubber glazing sealant: Compound of polymerized butyl rubber and inert fillers, solvent based, 95 percent solids, formed and coiled in release paper, tack-free in 24 hours, paintable, non-staining.

C. Miscellaneous Glazing Materials: Provide materials with proven record of compatibility with surfaces contacted in installation.

1. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
2. Setting Blocks: 100 percent silicone material with a Shore A durometer hardness of 85 plus or minus 5.
3. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

E. Expanded Cellular Glazing Tape: Closed-cell, PVC foam tape; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.10 FABRICATION

A. Factory fabricate glass and glazing products in sizes required to glaze openings indicated for project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements. Provide thickness indicated, or if not otherwise indicated, as recommended by glass manufacturer for application indicated.

B. Insulating glass: Provide manufacturer's standard units. Provide glass lights heat strengthened, except where fully tempered lights are indicated.

C. Heat strengthened and tempered glass:

1. Provide glass of type indicated, heat treated to strengthen glass in bending to not less than 2.0 times annealed strength for the strengthen glass and to not less than 4.5 times annealed strength for fully tempered glass.
2. Cut glass to required size before tempering. Comply with Glass Tempering Association recommendations.
3. Provide tongless tempered glass. When size limitations require tong edges, support each piece during tempering process so that tong marks will be concealed in the glazing system.

D. Safety Glazing: Provide fully tempered safety glass at location scheduled on the drawings as scheduled.

1. Provide fully tempered glass in exterior and interior doors and at panels adjacent to doors as indicated.
2. Provide fully tempered panels at other scheduled locations as indicated on the drawings of required by code.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine substrates, structure and installation conditions. Do not proceed with glazing work until unsatisfactory conditions have been corrected.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 PREPARATION

A. Protect glass from edge damage at all times during and after installation. Do not cut, seam, nip or abrade tempered glass.

B. Inspect each piece of glass immediately before installation and eliminate any which have observable edge damage or face imperfections.

C. Unify appearance of each series of lights by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, draw and bow oriented in the same direction as other pieces.

D. Clean glazing channels and other framing members to receive glass immediately before glazing. Remove loose coatings. Apply primer to joint surfaces receiving sealants when recommended by sealant manufacturer.

3.03 INSTALLATION

A. Comply with combined recommendations and technical reports of manufacturers of glass and glazing materials used and with National Glass Association “GANA Glazing Manual," except when more stringent requirements are indicated.

B. Glazing channel dimensions as shown are intended to provide for necessary minimum bite on the glass, minimum edge clearance, and adequate sealant thicknesses with reasonable tolerances. The glazier is responsible for correct glass size for each opening within the tolerances and necessary dimensions established.

1. Unless noted otherwise, clearances are 3/16 inch face clearance, ¼ inch minimum edge clearance, and ½ inch minimum glass bite.

C. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing and their technical representatives except where more stringent requirements are shown or specified.

D. Inspect each piece of glass immediately before installation and eliminate those which have observable edge damage or face imperfections.

E. Unify appearance of each series of lights by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, draw, and bow oriented in the same direction as other pieces.

3.04 GLAZING

A. Install setting blocks of proper size at quarter points of sill rabbet. Set blocks in thin course of the heel bead compound. Block shall be 1/16 inch less than the channel width.

B. Provide spacers inside and out and of proper size and spacing for glass sizes larger than 50 united inches, except where gaskets are used for glazing. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width; except with sealant tape, use thickness slightly less than final compressed thickness of tape.

C. Voids and Filler Rods: Prevent exudation of sealant or compound by forming voids or installing filler rods in the channel at the heel of jambs and head (do not leave voids in the sill channels) except as otherwise indicated, depending on light size, thickness and type of glass, and complying with manufacturer's recommendations.

D. Do not attempt to cut, seam, nip, or abrade glass which is tempered, heat strengthened, or coated.

E. Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

F. Tool exposed surfaces of glazing liquids and compounds to provide a substantial "wash" away from the glass. Install pressurized tapes and gaskets to protrude slightly out of the channel, so as to eliminate dirt and moisture pockets.

G. Clean and trim excess glazing materials from the glass and stops or frames promptly after installation and eliminate stains and discoloration.

H. Where wedge shaped gaskets are driven into one side of the channel to pressurize the sealant or gasket on the opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when subjected to dynamic movement. Anchor gasket to stop with matching ribs or by proven adhesives including embedment of gasket tail in cured heel bead.

3.05 FIELD QUALITY CONTROL

A. Watertight and airtight installation of exterior glass and glazing is required. Each installation shall withstand normal temperature changes, wind loading, impact loading (for operating doors) without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.

3.06 PROTECTION AND CLEANING

A. Protect glass from breakage immediately upon installation by attachment of streamers to framing held away from glass. Do not apply markers of nay type to surfaces of tinted and reflective glass. Remove non-permanent labels and clean surfaces.

B. Maintain glass in a reasonably clean condition during construction, so that it will not be damaged by corrosive action and will not contribute (by wash off) to the deterioration of glazing materials and other work. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.

E. Wash and polish glass on both faces not more than four days before acceptance of the work. Comply with glass manufacturer's recommendations for final cleaning.

3.07 GLAZING SCHEDULE

A. Typical IGU glazing units for exterior glazing conditions

Glass Type (GL-1):	**Insulating Units**
Total Thickness:	1 inch nominal.
Exterior Pane:	Clear tempered glass, 1/4 inch thick, with low “E” coating on #2 surface
Air Space:	1/2-inch, nominal, filled with argon gas and with warm edge spacer
Interior Pane:	Clear heat-strengthened glass, 1/4 inch thick, consisting of two laminated panes of 1/8 inch heat-strengthened glass bonded with 0.060 inch clear polyvinyl butyral interlayer

B. Spandrel glazing (very limited application where a ceiling structure is visible beyond the glass).

Glass Type (GL-2):	**Insulating Spandrel Glass**
Total Thickness:	1 inch nominal.
Exterior Pane:	Clear tempered glass, 1/4 inch thick, with low “E” coating on #2 surface
Air Space:	1/2-inch, nominal with argon gas and with warm edge spacer
Interior Pane:	Clear heat-strengthened glass, 1/4 inch thick, consisting of two laminated panes of 1/8 inch heat-strengthened glass bonded with 0.060 inch clear polyvinyl butyral interlayer with Opaci-coat 300 on #4 surface Color selected by Architect from manufacturer's standard color range.

C. IGU glazing units for exterior glazing conditions with ceramic frit

Glass Type (GL-3):	**Insulating Units**
Total Thickness:	1 inch nominal.
Exterior Pane:	Clear tempered glass, 1/4 inch thick, with low “E” coating on #2 surface
Frit	Frit Pattern: Viracon #5102 V901 White Viracon frit pattern on #2 surface.
Air Space:	1/2-inch, nominal, filled with argon gas and with warm edge spacer
Interior Pane:	Clear heat-strengthened glass, 1/4 inch thick, consisting of two laminated panes of 1/8 inch heat-strengthened glass bonded with 0.060 inch clear polyvinyl butyral interlayer

D. IGU glazing units for exterior glazing conditions non-laminated glazing units

Glass Type (GL-4):	**Insulating Units**
Total Thickness:	1 inch nominal.
Exterior Pane:	Clear tempered glass, 1/4 inch thick, with low “E” coating on #2 surface
Air Space:	1/2-inch, nominal, filled with argon gas and with warm edge spacer
Interior Pane:	Clear tempered glass, 1/4 inch thick,

E. Interior tempered glazing:

GLASS TYPE (GL-5)	**Tempered Glass**
Total Thickness	1/4 inch thick
	Clear tempered glass

F. Interior non-tempered glazing:

GLASS TYPE (GL-6)	**Annealed Glass**
Total Thickness	1/4 inch thick
	Clear glass

G. Interior acoustical glazing:

GLASS TYPE (GL-7)	**Acoustical Glass**
Total Thickness	1 inch thick
Composition	Glazing unit consisting of a 3/8 inch thick pane, air space and 1/4 thick pane
	Clear glass

END OF SECTION

SECTION 08 87 00

GLAZING SURFACE FILM

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes surface applied decorative films applied to interior vision glass as scheduled on the drawings.

1.02 ACTION SUBMITTALS

A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's product data including installation instructions and cleaning methods.

C. Samples: Submit all available color samples, for selection by the Architect.

D. Warranty: Manufacturer's standard current product warranty indicating warranty coverage.

1.03 QUALITY ASSURANCE

A. Obtain all products in this section from a single Manufacturer with a minimum of 10 years' experience.

B. Installer: Installation shall be performed by a trained and qualified installer, specialized and experienced in work required for this project.

C. Dealer and Applicator Qualifications: Provide documentation that dealer and applicator are authorized by manufacturer of window film to install window films.

1. Provide reference list of 5 projects of similar size on which applicator has installed window films. Include on the list the following:

   a. Name of building.
   b. Name and telephone number of management contact.
   c. Type of glass.
   d. Type of film.
   e. Amount of film installed.
   f. Date of completion.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer will ensure proper quality control during production, shipping, and inventory, clearly identify and label each film core with product designation and run number.

B. Deliver materials to Project site with manufacturer's labels intact and legible.

1.05 PROJECT CONDITIONS

A. Confirm appropriate substrate is suitable for mounting of glass finish components prior to start of installation.

B. Apply materials when environmental conditions are within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits. Application temperature range is 60 °F – 100 °F (16 °C – 38 °C).

C. Environmental Limitations: Do not install until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.06 WARRANTY

A. Warrant materials and workmanship for 5 years against defects after completion and final acceptance of Work.

1. Repair defects from faulty materials or workmanship developed during guarantee period, or replace with new materials, at no expense to Owner.
2. Warranty covers the following:
    a. Film will maintain solar reflective properties without cracking, crazing, delaminating, peeling, or discoloration.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Basis of Design:

1. 3M Building & Commercial Services Division (B&CSD), St. Paul, MN.

B. Product: Design based upon 3M™ CRYSTAL Glass Finishes Frosted.

2.02 MATERIAL PROPERTIES

A. General: Glass finishes field-applied application to glass or plastic material as visual opaque or decorative film.

B. Film: Vinyl

C. Adhesive: Acrylic, Pressure Sensitive, Permanent

D. Liner: Silicone-coated Polyester

E. Thickness (Film and Adhesive without Liner):

1. Frosted - 4.7 mils (120 microns)

F. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84, Class A:

1. Flame Spread: 25 maximum.
2. Smoke Developed: 450 maximum

G. Optical Performance: Complying with the following:

1. Basis of Design Product: CRYSTAL Frosted Decorative / Privacy Glazing Film:.
2. Ultraviolet Transmittance (ASTM E 903): 20 percent.
3. Visible Light Transmittance (ASTM E 903, ASTM E308): 72 percent.
4. Visible Light Reflectance (ASTM E 903): 12 percent.
5. Solar Heat Transmittance: 64 percent.
6. Solar Heat Reflectance: 10 percent.
7. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): 0.93.

H. Glass Cleaner: As recommended by glazing film manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine glass surfaces to receive film and verify that they are free from defects and imperfections, which will affect final appearance. Correct and note such deficiencies to Architect prior to commencing film application.

3.02 PREPARATION

A. Use protective tarps and drop cloths to cover interior finishes near window.

B. Turn off or cover heating and air conditioning ventilation ducts.

C. Clean window and window framing thoroughly with cleaning solution consisting of 90 percent water and 10 percent ammonia. Blade inside surface of window glass with industrial razors to insure removal of foreign contaminants.

1. Tape and seal cracked and deteriorating window sealant.

D. Place towel or other absorbent material on window sill or sash to absorb moisture accumulation generated by film application.

E. Thoroughly rinse glass from top to bottom with pressure spray tank.

F. Squeegee entire glass surface.

G. Dry glass edges and window frames using a lint-free towel.

3.03 INSTALLATION

A. Install window film per manufacturer's written instructions.

1. Inspect installation to insure proper application.
2. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

B. Examine substrates and supports, with the Installer present, for compliance with requirements indicated, installation tolerances, and other conditions that affect installation of the film. Correct unsatisfactory conditions before proceeding with the installation.

C. Film: Install window film according to manufacturer’s instructions.

1. Install smooth and even edge to edge of the glass without wrinkles, creases, bubbles, or air pockets.

3.04 CLEANING

A. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

B. After installation, remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

END OF SECTION

SECTION 09 51 13

REMOVAL AND RE-INSTALLATION OF ACOUSTICAL PANEL CEILINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes removal of acoustical panel ceilings, salvage and storage of panels, and re-installation of acoustical panels and installation of panels in existing ceiling suspended grid system.

1.02 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

A. Work Plan: Submit a plan for proposed procedures for the accomplishment of the work. The procedures shall provide for safe conduct of the work, careful removal and storage of materials specified to be salvaged, dust control, protection of property which is to remain undisturbed, and coordination with other work in progress. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations.

1.04 QUALITY ASSURANCE

A. Dust Control: The amount of dust resulting from removal, salvage and demolition operations shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area.

B. Before beginning any removal, salvage or demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to items that are to remain in place, and to be reused. Items damaged by the Contractor shall be repaired and restored to original condition, or replaced, as approved by the Architect. Coordinate the work of this section with all other work.

PART 2 – PRODUCTS

2.01 ACOUSTICAL PANELS

A. Existing salvaged acoustical panels in existing suspension system.

2.02 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M.

B. Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished, width to match removed suspension system metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Match removed ceiling suspension system.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel or aluminum.
5. Cap Finish: Match removed ceiling suspension system.

2.03 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.04 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated.

B. Layout openings for penetrations centered on the penetrating items.

3.03 REMOVAL

A. Determine required path requiring access to ceilings.

B. Remove ceiling tiles from structure; carefully remove suspended ceiling structure, fasteners and other related accessories. Take special care not to cause additional damage to original plaster ceiling and ornament when removing structure from the ceiling surface.

C. Salvaged items shall be removed in a manner to prevent damage, shall be packed or crated to protect the items from damage. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents. .

3.04 STORAGE

A. Acoustical ceiling panels shall be temporarily stored in location approved by the Construction Manager.

B. Panels must be stored in a interior space off the floor, in a conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes. well protected from potential abuse.

C. Store pairs of panels face to face and stack neatly not over 48 inches high.

D. Follow original manufacturer recommendations for required protection for the acoustical ceilings, including temperature and humidity limitations and dust control, so that the Work will be without damage and deterioration at the time of acceptance by the Owner.

E. Ceiling panels must be kept clean, dry, and protected from the elements. Store in environmental conditions which are the same as when they are removed.

F. Dust and loose dirt may easily be removed by brushing or with a vacuum cleaner. Vacuum cleaner attachments such as those designed for cleaning upholstery or walls do the best job. Be certain to clean in one direction only. This will prevent rubbing dust into the surface of the ceiling.

3.05 RE-INSTALLATION OF ACOUSTICAL CEILING PANELS

A. Verify that above ceiling work has been completed and suspended grid remains in place and is ready to receive re-installation of ceiling panels.

B. Ceilings shall not support material or building components other light fixtures. Duct work, plumbing and like work shall have its own support system and shall not use the ceiling system or suspension wires.

C. Verify that suspension wires have not been displaced.

D. Verify that drop-in light fixtures shall be supported directly from the fixture housing to the structure above

E. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way. Use procedures that will minimize damage or soiling of the units during installation.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

G. Arrange acoustical units and orient directionally patterned units (if any) with panel pattern matching original installation.

H. Install acoustical panel ceilings according to ASTM C636/C636M, and manufacturer's written instructions.

I. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

J. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

3.06 CLEANING

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

B. Upon completion of the work, portions of structure to remain and adjacent areas and structures shall be cleaned of dust, dirt, and debris caused by salvage and re-installation operations.

END OF SECTION

SECTION 09 05 61

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Construction and testing requirements for interior floor slabs and supplements requirements of Section 03 30 00 – Cast-in-Place Concrete and the Structural Drawings for the following:

1. Concrete materials.
2. Slab finish.
3. Curing of slabs.
4. Concrete Moisture and pH testing.
5. Moisture and pH control (remediation as needed).

B. Provide floor slab surfaces suitable for installation of floorcovering materials. No contract adjustments are allowed, since the Contractor controls construction schedule, concrete work, timing of building enclosure, and temporary facilities such as construction drying.

C. Related Sections:

1. Section 01 31 00 – Project Coordination: Preconstruction conference.
2. Section 03 30 00 – Cast-In-Place Concrete
3. Division 09 – Flooring Sections.

1.02 SLAB DRYNESS PRECEDENT TO ADHESIVE FLOORING INSTALLATION

A. Correlation of Slab Relative Humidity to Moisture Vapor Emission: For purposes of this contract, the fallowing correlation applies.

Slab Relative Humidity %	**Moisture Emissions lbs/1000 sf/24 hours** Moisture Emissions lbs/1000 s.f./24hrs
95%	20 lbs.
90%	15 lbs.
85%	10 lbs.
80%	7 lbs.
78%	5 lbs.
75%	3 lbs.

B. General: Follow floor covering manufacturer's recommendations for slab dryness. In the absence of such recommendations, the following guidelines apply.

C. Maximum 3-Pound Emission and pH of 9 or less: Suitable for installation of any type floor covering using normal adhesives.

D. Maximum 5-Pound Emission and pH of 9 or less: Suitable for installation of:

1. Carpet with vapor permeable backing (e.g. jute).
2. Other floor coverings using special adhesives approved by floor covering manufacturer.

E. Maximum 7-Pound Emission:

1. Suitable for installation of thin-set ceramic tile and similar materials using Portland cement base mortar.
2. Remediation or special adhesives required for installation of other floor coverings Verify pH within limits specified by adhesive manufacturer.

F. More than 7- Pound Emission: Remediation or additional drying required.

1.03 INFORMATION SUBMITTALS

A. Qualification Data: Submit for testing agency. Submittal is for information only.

B. Field Test Reports: Submit layout plan and test results for each location tested indicating time and date of each test. Report test results in chart form.

1. Calcium Chloride Test Method: Indicate test dates, start/stop time, start/stop weight, weight gain in grams, water vapor emission rate, and pH levels.
2. Relative Humidity Test Method: Indicate test dates, time, depth of test well, in-situ temperature, relative humidity and pH levels.
3. Submit record of ambient air temperature, ambient relative humidity, and floor slab surface temperature when test sites are prepared, start of test, and end of test.
4. Indicate condition of building enclosure including position of operable windows and exterior doors when test sites are prepared, start of test, and end of test.
5. Indicate operational status of HVAC systems maintaining environmental condition of spaces where tests are conducted when test sites are prepared, start of test, and end of test.

C. Product Data: Submit for each type of floor slab moisture remediation product proposed for use.

D. Warranty: Submit specimen warranty for each type of floor covering material installed.

1.04 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 – Project Coordination.

B. Scheduling: Schedule work to permit concrete moisture testing to be completed minimum one week and maximum 3 weeks before floor coverings are installed.

C. Testing Agency Qualifications: At a minimum, testing agency or individuals shall demonstrate verifiable experience in vapor emission and pH testing, or be certified by recognized organizations, such as the Institute of Inspection, Cleaning and Restoration Certification (IICRC), or equivalent.

D. Contractor shall be responsible for obtaining confirmation from the respective finish flooring manufacturer that floor covering installation may proceed under the guidelines stated in this section, without invalidating the warranty of each respective floor covering material manufacturer.

1. Additional testing by floor covering installer to determine suitability of slab is recommended but not required.

1.05 PROJECT CONDITIONS

A. Ambient Conditions:

1. Do not perform concrete moisture testing until building is enclosed and HVAC system is operational.

B. Substrate: Proceed with testing only after the following conditions have been attained:

1. Concrete is properly cured, 28-days, minimum.
2. Concrete has been cleaned to remove curing compounds and sealer, and is dry.
3. Concrete has been maintained at the same temperature and humidity conditions as the final floor covering will be exposed to for 48 hours before, during, and continuously after conducting testing.

1.06 WARRANTY

A. Warrant floor covering installations against failure due to slab moisture emissions and pH.

B. Warranty to include labor and materials required to remove failed flooring, remedy slab emissions, and install new flooring. Warranty may be underwritten by flooring manufacturer, remediation system manufacturer, Contractor, or a combination of those entities.

1. Warranty period: 2 years.

PART 2 – PRODUCTS

2.01 FLOOR SLAB MOISTURE REMEDIATION PRODUCTS

A. Systems listed below are recommended by their respective manufacturer to reduce the moisture emissions from the named maximum to 3 lbs 1000 s.f./24 hours.

B. Acceptable Manufacturers:

1. Ardex: Ardex MC
2. CreteSeal: CS 2000 2-day system.
3. Floor Seal Technology: System 300
4. Koster: VAP 1 2000.
5. Vexcon Chemical: "Moisturebloc Emulsion Vapor Reduction"
6. W.F. Taylor "Lockdown Moisture Control System":

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify new concrete floors have cured minimum 28 days.

3.02 PREPARATION

A. When a building HVAC system is not operational and maintaining test areas at design operational conditions, install recording hygrometer or data logger in each separate test area to record ambient temperature and relative humidity beginning 48 hours before start of tests until completion of tests within each area.

B. Identify three moisture test sites for first 1,000 sf and one moisture test site for each additional 1,000 sf of floor area receiving floor covering on each separate floor slab.

1. Layout test site locations uniformly distributed throughout each test area.

C. Mechanically clean each test site to remove oils, laitance, curing compounds, adhesives, and other contaminates affecting water vapor emissions.

1. Remove cleaning residue.
2. Do not apply water or other liquid to floor slabs and test sites.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform concrete moisture tests and inspections and prepare test reports:

B. Acceptance Criteria:

1. Concrete floor slabs will be considered acceptable for installation of floor finishes when:

   a. Calcium Chloride Test Result: 3 lb of water/1000 sf in 24 hours maximum moisture vapor transmission rate.
   b. Relative Humidity Test Result: 75 percent maximum relative humidity.
   c. pH Test Result: Within alkalinity range of 7.0 to 9.0.

2. When concrete floors do not meet acceptance criteria, obtain recommendations from floor finish manufacturers for remediation measures necessary to permit successful floor finish installation.

C. Concrete Moisture Testing – General:

1. Conduct calcium chloride test and relative humidity test at each test site.
2. Conduct one pH test at each test site.
3. Moisture testing requires controlled environment of 65 to 85 F and 40 to 60% R.H. for minimum 48 hours before test until completion of test
4. Conduct pH tests per ASTM F 710 concurrent with moisture testing. Consistent readings of pH 9 or less require no action; for higher pH levels consult manufacture of product (adhesive or remediation system) in contact with slab surface for correction requirements.

D. Calcium Chloride Testing: Acceptable Method ASTM F 1869

E. Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor using Anhydrous Calcium Chloride.

1. Emission rate test may be used to confirm performance of proprietary moisture remediation systems.
2. Film forming curing compounds and remediation systems require emission rate test to verify performance and suitability to receive flooring. Sampling frequency reduced to 2 tests per representative area.
3. For floor finishes requiring scarification (e.g. shotblasting) of the slab surface, perform emission testing after scarification.

F. Relative Humidity Testing: Perform tests in accordance with ASTM F 2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes.

1. Recommended product: Wagner Electronics "Rapid RH" probes.
2. Probe depth below top surface: 40 percent of slab thickness for slab on grade and slab on metal deck.
3. Drill test hole at each test site to accommodate test sleeve.
    a. Hole Diameter: In accordance with test equipment manufacturer’s instructions.
    b. Drilling Fluids: Not permitted.
4. Vacuum dust and debris from test hole.
5. Insert sleeve, to the full depth of test hole. Cap or plug sleeve to prevent test hole contamination.
6. Permit the test site to acclimate for minimum 72 hours before measuring relative humidity.
7. Remove sleeve plug and insert probe to bottom of test hole. Allow test probe to reach temperature equilibration with concrete slab.
8. Measure and record temperature and relative humidity at the test site.

G. Test Reports: In addition to information specified by ASTM standard, calculate results normalized to 75 degrees F and 50 percent R.H. ambient conditions and slab temperature.

3.04 FLOOR SLAB MOISTURE REMEDIATION APPLICATION

A. General: Comply with remediation product manufacturer's recommendations for surface preparation, application, curing, and protection of moisture remediation system.

END OF SECTION

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes non-load-bearing steel framing members for the following applications:

1. Non-Structural steel framing systems for interior partitions.
2. Suspension systems for gypsum board ceilings, soffits, and grid systems.
3. Wall furring.
4. Backing plates for attaching wall hung items, toilet accessories, surface applied hardware, etc.

B. Related Sections:

1. Section 05 40 00 – Cold-Formed Metal Framing for exterior load-bearing wall studs.
2. Section 06 10 00 – Rough Carpentry: Blocking
3. Section 09 29 00 – Gypsum Board

1.02 DEFINITIONS

A. Non-Load Bearing Metal Support Systems: Cold formed metal framing assemblies supporting only loads directly attached to the framing and minor axial and/or transverse loading not greater than 5 psf, except as indicated otherwise.

B. Suspended Metal Support Systems: Cold formed metal framing assemblies, generally horizontal, characterized by wire hanger supports and supporting only loads attached to the framing.

1.03 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit data and installation instruction for each materials and accessories to be used in the work, including descriptive data to show compliance with this specification. Submit specific assembly requirements for each different composite assembly, including the following:

1. Structural Performance Data: For each different assembly, submit data indicating gage and framing requirements based upon size of framing required, framing heights/configuration, composite assembly configuration, and structural performances required.
2. Head of Wall Fire Rated Assemblies: Submit UL Listed components accompanied with product evaluation report, ICC-ES listed or as required by the governing code authority.

C. Shop Drawings: Submit shop drawings showing fabrication and installation of the suspended ceiling framing systems and wall framing support systems, including methods of anchorages and details of connections within the assemblies and to adjoining construction.

1. Show spacing, sizes, weights or gages of all framing members.
2. Show lateral bracing for each different type of partition assembly which extends above the ceiling, but not to structure; bracing shall meet the load resistance as specified.
3. Show type of anchors proposed for support of ceiling suspension systems; include required tension or pull-out values which must be met in the field to comply with overall ceiling design.
4. Clearly indicate on shop drawings any proposed deviations or changes from Contract Drawings. Architect's approval is required for any proposed deviation or change. .

1.04 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For cold-formed steel framing and accessories:

1. Products to be certified under a qualified third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 Accreditation Criteria for Inspection Agencies.

B. Design Data: Where designs are not verifiable by Structural Performance Data, submit structural design calculations referenced to shop drawings for all framing members and anchorages demonstrating

compliance with structural criteria previously specified. Calculations shall indicate the required ultimate strength and tension values in pounds for all anchors used in ceiling support. Calculations shall be prepared, stamped and signed by a Structural Engineer, licensed in the State of Ohio.

C. Product Test Reports: Submit laboratory tests certifying STC ratings for acoustically rated partitions as indicated.

D. Codes: Comply with all pertinent requirements of IBC as indicated on the Structural Drawing Notes for Seismic Design Category indicated.

1.05 PERFORMANCE REQUIREMENTS

A. General: Manufacturer's non-load-bearing steel framing members, including anchorage and accessories, capable of withstanding the effects of the following performance criteria:

1. Steel Studs and Runners: Minimum depth as indicated, and in accordance with the following performance requirements:

   a. Interior Metal Stud/Gypsum Board Assemblies, Typical Locations: Withstand lateral loading (air pressure) of 5 psf with deflection limit not more than L/240 of partition height.
   b. Interior Metal Stud/Gypsum Board Assemblies at Vertical Shafts, exceeding 15'-0" height. Withstand lateral loading (air pressure) of 10 psf with deflection limit not more than L/240 of partition height.
   c. Walls with Ceramic Tile Finish: All standard wallboard areas to receive ceramic tile finishes shall be constructed for deflection not to exceed 1/360 of the wall height when subjected to a positive and negative pressure of 5 psf.
   d. At jambs of door and other openings provide full-height double studs at each side of opening. Extend jamb studs through suspended ceilings and attach to underside of overhead structure if the suspended ceiling system cannot withstand forces imposed by door swings.
   e. Where partition heights exceed stud manufacturer's recommended spans, provide one of the following:

      1) Heavier stud gage.
      2) Closer stud spacing.
      3) Deeper stud size (space permitting; as approved by Architect).
      4) Above ceiling bracing, anchored to structure above. Coordinate with MEP systems.

2. Ceilings: Limited to deflection of suspended metal stud ceiling system with gypsum board finish of L/240, and/or suspended metal stud ceiling system with gypsum board and tile finish of L/360.
3. Soffits: Limited to deflection of metal stud framing system with gypsum board finish of L/360.
4. Grid Suspension System (Ceiling): Limited to deflection of main beams and cross furring of L/240.

1.06 QUALITY ASSURANCE

A. Domestically Produced Steel: Steel referenced in this section shall be produced domestically.

B. Fire-Resistance Rated Assemblies: For fire-resistance-rated assemblies that incorporate non-structural steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency. Products used in the assembly shall carry a classification label from Underwriters Laboratories (UL).

1. Construct fire-resistance rated partitions in compliance with tested assembly requirements indicated on drawings.
2. Rated assemblies to be substantiated from applicable testing using proposed products, by Contractor.
3. Both metal framing and wallboard manufacturers must submit written confirmation that they accept the other manufacturer's product as a suitable component in the assembly. Acceptance is as follows:

   a. If installation of both products is proper, no adverse effect will result in the performance of one manufacturer's product by the other's product.
   b. Combining products can be substantiated by required assembly tests.

C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

D. Manufacturer/Fabricator/Supplier Requirements:

1. Work of this Section is to be designed, fabricated, and supplied by a company with a minimum of ten (10) years of continuous, uninterrupted experience in manufacturing, fabricating, and supplying products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units within constraints of Construction Schedule.
2. Member of the Certified Steel Stud Association (CSSA). or Steel Framing Industry Association (SFIA).

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

D. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice."

1.08 COORDINATION

A. Coordination Drawings: Coordinate installation of suspension systems with installation with following elements of the Work:

1. Overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
2. Ceiling suspension and supporting assemblies are located with other trades, including but not limited to air distribution system; lighting (recessed and surface mounted); fire-protection piping; concealed metal fabrications; art attachment points; A/V and Tele-data outlets and recess assemblies as indicated.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Provide products by Steel Framing Industry Association (SFIA) Members in good standing found at http://www.archtest.com/certification/SFIA_SteelFraming_Intertek.aspx

B. Products to be certified under a qualified third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 Accreditation Criteria for Inspection Agencies.

C. Acceptable Manufacturers:

1. Clark/Dietrich, West Chester, OH.
2. Marino\WARE, South Plainfield, NJ.

D. Grid Suspension Systems:

1. Armstrong World Industries, Inc., Lancaster, PA
2. Chicago Metallic Corp., Chicago, IL
3. USG Interiors, Inc., Chicago, IL

2.02 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Framing Members, General: Comply with AISI S220 for conditions indicated.

1. Steel Sheet Components: Comply with AISI S220, Section 10 requirements for metal, unless otherwise indicated.
2. Protective Coating: Comply with ASTM C 645; ASTM A 653/A 653M G40 (Z120), Coating with minimum equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120) or DiamondPlus® coating; roll-formed from steel meeting mechanical and chemical requirements of ASTM A 1003 with a zinc-based coating. Galvannealed products are not acceptable.

    a. Coatings shall demonstrate equivalent corrosion resistance with an evaluation report acceptable to the authorities having jurisdiction.

C. Steel Studs and Runners: AISI S220, with flanged edges of studs bent back 90 degrees and double over to form 3/16-inch-wide minimum lip (return) and complying with the following requirements for minimum thickness of base (uncoated) metal:

1. Minimum Base Metal Thickness: 0.0296 inch or equivalent thickness.

    a. Abuse-Resistant and Impact-Resistant Board assemblies: Minimum base metal thickness of 0.0296 inch (30 mil) per GA-216. No EQ studs permitted in these assemblies.

2. Thickness: 20 gauge equivalent drywall stud, 0.0181 minimum base metal thickness.
3. Web Depth: As indicated.
4. Width and spacing of studs shall be not less than that required to comply with ASTM C754, maximum deflection of L/240 at 5 lbf per square foot.
5. Tile finishes applied to cementitious backer units maximum deflection shall be L/360.
6. Partitions Supporting Wall Mounted Casework: 0.0538 inch (16 gauge) minimum base metal thickness.
7. Member Description: ProSTUD 20 (20ga equivalent drywall stud) 70ksi.

D. Non-Structural Track: Cold-formed galvanized steel runner tracks, ClarkDietrich ProTRAK drywall track, in conformance with AISI S220 for conditions indicated below:

1. Flange Size: 1-1/4 inch.
2. Web Depth: Track web to match stud web size.
3. Minimum Base-Steel Thickness: Track thickness to match wall stud thickness or as per design.

E. Slip-Type Head Joints: When attached to structural components or where indicated, provide one of the following:

1. Double-Runner System: AISI S220 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0179 inch.

G. Channel Bridging and Bracing: 0.0538-inch base-steel thickness, with minimum 1/2- inch- wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: AISI S220

1. Minimum Base Metal Thickness: 20 gauge (0.0296 inch).
2. Depth: 7/8 inch.

I. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

J. Cold-Rolled Furring Channels: 0.053-inch base-steel thickness, with minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.

K. Z-Shaped Furring: With nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 3/4 inch, minimum base-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

L. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

2.03 PRE-ENGINEERED METAL FRAMING COMPONENTS

A. Slip-Type Head Joints: When attached to structural components or where indicated, provide one of the following:

1. Single Long-Leg Runner System: AISI S220 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging or cold-formed channel with clop angles located within 12 inches of the top of studs to provide lateral bracing.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) ClarkDietrich; Spazzer® 9200 Bridging and Spacing Bar.

2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) ClarkDietrich: MaxTrak Slotted Deflection Track.
      2) Steel Network Inc. (The); VertiClip SLD or VTD Series.

3. Deflection and Firestop Track: Ceiling runner designed to allow head-of-walls to compress or extend with movement of structure above while maintaining the fire-rating of the wall assembly by a factory applied cured intumescent fire stop material affixed to steel profile. Comply with requirements of AISI S220, of thickness indicated for studs and of width to accommodate depth of studs indicated. The fire-rated assembly shall be capable of one inch of unencumbered movement as required and indicated on the drawings. The assemblies shall have been tested and listed in accordance with UL 2079 or ASTM E1966, and ASTM E814.

   a. Basis of Design Product/Standard: : [**BlazeFrame DSL**] [**MaxTrak**]] by ClarkDietrich or “Fire Trak” manufactured by Fire Trak Corp., Kimball, MN..

4. Blocking/Backing:

   a. Manufacturer/ Product: Subject to compliance with requirements, provide ClarkDietrich; Danback Fire-Treated Wood Backing Plate D16F.

2.04 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch- diameter wire.

B. Hanger Attachments to Overhead Decks: Suitable for application indicated, fabricated from corrosion resistant materials, with eyepins, clips, or other devices for attaching hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by the complete ceiling systems.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.

D. Carrying Channels: Cold-formed, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges, with manufacturer's standard corrosion-resistant coating.

1. Depth: 2-1/2 inches.

E. Furring Channels (Furring Members):

1. Cold-Formed Channels: 0.0538-inch bare-steel thickness, with minimum 1/2- inch- wide flanges, 3/4 inch deep.

2. Steel Studs: AISI S220.
    a. Minimum Base-Metal Thickness: 0.0296 inch or 0.0181 inch equivalent.
    b. Depth: As indicated on Drawings.
3. Hat-Shaped, Rigid Furring Channels: AISI S220, 7/8 inch deep.
    a. Minimum Base Metal Thickness: 0.0296 inch.
4. Resilient Furring Channels:
    a. Manufacturer's standard product designed to reduce sound transmission, complying with AISI S220 for material, finish and widths of face and fastening flange, fabricated to form 1/2-inch deep channel.

F. Grid Suspension System for Ceilings: AISI S220, direct-hung system composed of main beams and cross-furring members that interlock.
1. Products: Subject to compliance with requirements, provide one of the following:
    a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    b. Chicago Metallic Corporation; 640/660 Drywall Grid System.
    c. USG Corporation; Drywall Suspension System.

2.05 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow- metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. General: Prepare substrates and connecting work to enable the best and most complete installation per industry standards of the work of this Section.

B. Coordination:
1. Coordinate installation of backing plates; verify length, height, location and number of backing plates required with manufacturers of items to be supported.
2. Coordinate installation of anchorage devices for suspended ceilings/soffits and walls, verifying that spacing and rated strength are correct for anticipated load conditions.

C. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.03 INSTALLATION, GENERAL

A. Erect framing systems in accordance with ASTM C754, except where exceeded by pertinent codes and regulations for rated construction and recommendations of the manufacturer and where otherwise detailed; securely anchor all members in position.

B. Accurately lay out all partitions; coordinate the work of this Section with that of other sections for concealed work.

C. Independently support partitions, furring and ceiling suspension systems; do not attach ducts, pipes, etc. to supports. Do not support suspension systems from any electrical, HVAC, plumbing or sprinkler system components. Do not drill or "shoot" into structural members in any manner that would impair its structural integrity.

D. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

1. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, comply with United States Gypsum's "Gypsum Construction Handbook."

E. Install bracing at terminations in assemblies.

F. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

G. Install framing members to preclude direct physical contact with conduits, pipe, and ducts; coordinate with installation of sleeves for mechanical penetrations.

H. Erect framing in true planes to provide solid backing for finish materials; tolerance limitations are specified under the various finishes unless noted herein.

I. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement.

1. Where building structure abuts ceiling perimeter or penetrates ceiling.
2. Where partition framing and wall furring abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly while laterally supporting the assembly.

3.04 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Space studs as follows:

a. Single-Layer Application: 16 inches o.c., unless otherwise indicated.
b. Multilayer Application: 16 inches o.c., unless otherwise indicated.
c. Tile backing panels: 16 inches o.c., unless otherwise indicated.

B. Stud Spacing:

1. Install studs at on centers indicated above, unless otherwise indicated or required to meet structural requirements for maximum allowable deflection, but not exceeding manufacturer's recommendations or requirements for fire rated construction for stud type, length and loading.
2. Provide double studs (back-to-back) at each side of door, duct penetrations, or other wall openings and at partition ends.
3. Install structural studs adjacent to door and relight openings, and at partitions as scheduled on drawings or required to meet structural requirements for maximum allowable deflection.

C. General: Construct each partition, including all necessary offsets in framing; adjust location of, and vary size of, studs as required to provide continuous wall planes for their entire extent; vary finish thicknesses if necessary.

D. Floor Track:

1. Align floor tracks to the partition layout. Secure tracks to concrete with powder-driven fasteners or concrete stub nails, spaced not to exceed 24 inches on center and within 2 inches on ends. Provide fasteners at all corners and ends of runner tracks; space fasteners a minimum of 3 inches from edge of slab or corner.

2. At partitions indicated to receive acoustical insulation, apply two (2) continuous strips of sealant tape to bottom side of tracks prior to installation; place strips on outside edges. In lieu of sealant tape, two continuous beads of gun grade acoustical sealant may be used.

E. Top Runner Track (Full Height Partitions): For partitions which go to structure above, secure deep flange top track to valleys of metal deck units with powder-driven fasteners or welds, spaced not to exceed 12 inches on center.

1. Typical Slip-Type Head Joints or Vertical Deflection Clips: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

F. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings and at partial height partitions. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

G. Partitions Which Extend Above Ceiling, Not to Structure: Lateral force bracing shall meet the requirements as previously specified. Unless otherwise required by the governing jurisdiction, lateral bracing shall be accomplished by using minimum 20 gage steel "C" studs secured to the runner track and structure above at an angle of 45 degrees from the plane of the ceiling.

1. Place studs not to exceed 4 feet on center; studs may be located on either side of the partition, depending upon obstructions above. Secure studs to top track using two #8 screws, and to structure above using powdered actuated fasteners.
2. Bracing system shall be per ICC-ES Legacy Report 4071.

H. Studs: Set studs vertically in tracks with open side of studs facing in same direction. Align all punch-out holes in studs within a continuous length of wall to receive utilities. Use full length studs between tracks to full engage top and bottom runner track, except as otherwise indicated. Where partitions extend to structure above (except as required for fire-rated assemblies, above), cut studs short of total height to allow for minimum of 3/4 upward and downward vertical movement at head, and install vertical deflection clips; do not secure studs to top track; studs shall rest on bottom runner track in all conditions.

1. Place studs in direct contact with all door frame jambs, abutting partitions, partition corners and existing construction elements. Where studs are placed directly against exterior concrete or masonry walls, install asphalt felt strips between studs and wall surfaces.
2. Provide positive attachment to bottom tracks for studs at partition corners and intersections and adjacent to door and relight openings using 3/8 inch self-tapping screws on both stud flanges; screw attach or crimp all remaining studs at bottom.
3. Provide 20 gage by 2 inch wide continuous alignment strap secured to each stud along top as detailed.
4. Where studs cannot run to underside of construction above due to equipment or ductwork, provide built-up headers consisting of runner tracks and studs spanning the distance.

I. Studs at Door and Relight Frames: Secure studs to jamb anchor clips of each door frame and relight frame by using two (2) self-tapping screws or bolts per clip. Over metal door and relight frames, install a horizontal cut to length section of runner track with web flange bend at each end and securely attach to adjacent vertical studs. Provide runner tracks of same gage as jamb studs. Install cut-to-length studs over opening headers at standard spacing extending to the top runner.

1. Structural Steel Support Framing: Provide framing as indicated to conceal all assemblies.

J. Framing of Openings: Provide rough framing at openings using full length studs adjacent to jambs and horizontal head and sill tracks. Cut horizontal tracks to length, split flanges and bend webs at ends for flange overlays and screw attach to jamb studs. Install cut-to-length intermediate studs between jamb studs at head and sill sections at same spacing as full length studs.

K. Plumbing Chases and Braced Cavity Partitions: Where a partition is indicated to be constructed from double rows of studs, maintain mechanical isolation between rows of studs; coordinate with plumbing and electrical work to ensure that no item is anchored to studs on opposite sides of wall and that acoustical separation is maintained between each side of the partition. Space bracing (runner tracks) not to exceed 16 inches on center horizontally and 4’-0” maximum on center vertically. Fasten to studs with two No. 8 by 1/2 inch long self-drilling, self-tapping screws in each stud.

L. Miscellaneous Assemblies: Provide framing for elements shown on the drawings in accordance with approved drawings and standards of practice indicated.

M. Column and Beam Clips: Install in accordance with manufacturer's instructions and approved UL Design No.

N. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

O. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.05 GYPSUM BOARD SUSPENSION SYSTEM FRAMING

A. General: Install suspension systems to comply with ASTM C636, as required to support all design loads, and with manufacturer's directions. Support suspension system from overhead construction in solid and permanent manner, fully capable of carrying imposed loads. In no case shall deflection exceed 1/360 of any span.

B. Hanger Wires: Locate hangers a maximum of 8 inches from each end and spaced 48 inches on center along each main runner; provide additional hanger wires at all four corners of light fixtures and at mid-span of cross tees along sides of light fixtures. Do not hang wires more than 1 in 6 out of plumb, unless counter sloping wires are provided.

1. Secure hanger wires by looping and wire-tying, either directly to structure or to inserts, eye-screws, or other approved devices which are secure and appropriate for substrate. Install fasteners for securing hanger wires to structure in accordance with manufacturer's recommendations. Provide hanger wires capable of carrying not less than 100 pounds allowable load. Secure wires to runners by one loop and three tight twists in 1-1/2 inches. Splices not permitted.
2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structure or ceiling suspension system. Splay hangers only where required to miss obstructions and off-set resulting horizontal force by bracing, countersplaying or other equally effective means.

C. Trapeze Supports: Provide trapeze or other supplementary support members at obstructions to maintain hanger spacing. Provide minimum trapeze suspensions of back-to-back 1-1/4 inch cold-rolled channels for spans exceeding 48 inches. Provide additional hangers, struts or braces as required at ceiling breaks or discontinuous areas.

D. Additional Hangers: When weight of components supported on main runners or cross tees causes total dead load to exceed deflection capability, provide additional hangers as recommended by suspension system manufacturer. Do not apply system loads that may result in rotation of runners or tees.

E. Grid System:

1. Main Runners: Support main runners directly from hanger wires, spaced not to exceed 48 inches on center.
2. Cross Tees: Install cross tees spaced not to exceed 16 inches on center; install additional cross tees 8 inches from each end of each drywall panel. At recessed light fixtures, install cross tees on four sides for light fixture support.

F. Wall Track: Install wall track wherever suspension system meets vertical surfaces. Cut suspension components to fit into the wall track. Attach at 16 inches on center maximum, and within 3 inches of ends. Install track level with suspension system.

G. Stud Framed Ceiling and Soffits: Where ceilings or soffits are indicated for direct attachment to stud framing, or where suspension system is not used, install studs at a spacing not to exceed 16 inches on center. Provide hanger studs as required and where not indicated; size studs for spans used. All studs shall be screwed attached using minimum 3/8 inch self-tapping screws on both stud flanges.

H. Allowable Installation Tolerances: Provide framing to conform with the following allowable tolerances:

1. Wall Installation Tolerance: Install framing members plumb within ¼ inch in 10 ft-0 inches.
2. In-line Stud Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3. Suspended Ceiling Tolerance: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
4. Curved Framing: Form to true and uniform lines using standard shaped track or pre-engineered track and studs forming curve(s) with straight lengths tangent to arcs.

3.06 WALL BACKING PLATES

A. Wall Backing Plates: Fabricate from galvanized steel stud runners, not less than 16-gage by 6 inches wide; notch at stud locations as detailed. Attach with flat head sheet metal screws; provide a minimum of three (3) screws per each bearing point.

1. Provide in wall or partition framing system wherever wall-hung cabinets, equipment, accessories, and handrails are indicated on drawings; for all wall-mounted finish hardware, including door stops; and where required for mounting of miscellaneous items requiring backing.
2. Backing plates shall span full length of attached item

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Interior gypsum board faced walls, partitions, and ceiling assemblies, and supplementary items necessary for installation as follows.

1. Drywall trim and finishing (joint tape and compound treatment).
2. Acoustical treatment within partition assemblies as indicated on drawings.
3. Special requirements for acoustical wall construction.
4. Repair work at existing gypsum board assemblies.
5. Skim coat and latex primer for painted walls and ceilings indicated to receive high gloss and deep tone paint color paint finishes, etc. as indicated.
6. Skim coat and latex primer for painted walls and ceilings indicated to receive Level 5 finish.

B. Related Sections:

1. Section 09 22 16 – Non-Structural Metal Framing: Wall framing, ceiling suspension systems, wall furring, etc.
2. Section 09 3013 – Tiling
3. Section 09 91 00 – Painting: Paint coatings on gypsum board.

1.02 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 for definitions of terms not defined in this Section or in other referenced quality standards.

B. Damage: Stored or installed paper faced gypsum board materials not specifically manufactured as “moisture-resistant products” shall be classified as defective and nonconforming Work if they have been exposed to wetness or dampness at any time prior to Substantial Completion or if they exhibit evidence of active or dormant mold or mildew.

1.03 REFERENCE STANDARDS

A. In addition to requirements shown or specified, comply with applicable provisions of following for design, materials, fabrication, and installation of component parts:

1. GA 216 – Application and Finishing of Gypsum Board by Gypsum Association.
2. GA 214 – Recommended Levels of Gypsum Board Finish by Gypsum Association.
3. GA 600 – Fire Resistance Design Manual by Gypsum Association

1.04 ACTION SUBMITTALS

A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer’s technical literature for each product and system indicated.

1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

1.05 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.

B. Field Quality Control Reports: Written report of testing and inspection required by “Field Quality Control”.

C. Manufacturer’s Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.

D. Qualification Data:

1. For manufacturer and installer.
2. For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
3. Architect may waive Submittal of Qualification Data for Manufacturers listed in this Section.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer with not less than 5 years' experience with successful production of products and systems similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 5 years, and with sufficient production capability, facilities and personnel, to produce required Work.

1. Source Limitations: Provide gypsum products manufactured within the United States from materials free of sulfur, formaldehyde or other deleterious chemicals. Natural gypsum ore shall be mined in North America. Synthetic (Byproduct) gypsum shall be pure calcium sulfate from domestic sources.

B. Installer Qualifications:

1. Experience: Installer with not less than 5 years' experience in performing specified Work similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 5 years and with sufficient production capability, facilities, and personnel to produce required Work.
2. Supervision: Installer shall maintain a competent supervisor who is at Project site during times specified Work is in progress that is experienced in installing systems similar to type and scope required for Project.

C. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with minimum of 5 years' experience in providing recommendations, observations, evaluations, and problem diagnostics. Sales representatives are not acceptable.

D. Fire Resistance Rated Assembly Characteristics: Provide materials and construction identical to those tested according to ASTM E 119/NFPA 251/UL 263 by one of following independent testing and inspecting agency as evidenced by design designation included in their associated approval manual:

1. UL - "Fire Resistance Directory", Category BXUV.
2. GA 600 - "Fire Resistance Design Manual".
3. Other agency acceptable to authorities having jurisdiction.

E. Sound (STC) Resistance Rated Assembly Characteristics: Provide materials and construction identical to those tested according to ASTM E 90 and classified according to ASTM E 413 by independent and testing agency acceptable to authorities having jurisdiction.

1.07 MOCKUP

A. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for the completed Work:

1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
    a. Show typical components, attachments to building structure, and requirements of installation.
    b. Field Samples for Gypsum Board Finishing: Build 10 ft (3 m) square gypsum board (attached to metal studs) area for each finish level specified. Include not less than one tapered-to-tapered edge gypsum board joint and cut edge-to-cut edge gypsum board joint.
2. Clean exposed faces of mock-up.
3. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Protect accepted mock-up from the elements with weather-resistant membrane.
6. Obtain Architect's acceptance of mockups before starting fabrication.

7. Maintain mock-ups during construction in an undisturbed condition as a standard for review of the completed Work.
8. Acceptance of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor, submitted to Architect in writing, and accepted by Architect in writing.
9. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.08 PRE-INSTALLATION CONFERENCE

A. Pre-Installation Conference: Before Work begins, conduct conference at Project site to comply with requirements of applicable Division 01 Sections.

1. Required Attendees:

   a. Owner.
   b. Architect.
   c. Contractor, including superintendent.
   d. Installer, including project manager and supervisor.
   e. Manufacturer’s qualified technical representative.
   f. Installers of other construction interfaced with Work.

2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:

   a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
   b. Review Work requirements (Drawings, Specifications, and other Contract Documents).
   c. Review required submittals, both completed and yet to be completed.
   d. Review and finalize construction schedule related to Work and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   e. Review required inspection, testing, certifying, and material usage accounting procedures.
   f. Review environmental conditions and procedures for coping with unfavorable conditions.
   g. Resolve deviations or differences between Contract Documents and the manufacturer’s specifications.

3. Contractor shall record discussions of conference, including decisions and agreements reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Reference: Gypsum Association GA-801: Handling and Storage of Gypsum Products.

B. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

C. Store materials inside under cover and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

D. Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal corner beads and other trim from being bent or damaged.

E. Protect gypsum board panels to prevent damage to edges, ends, and surfaces.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Comply with requirements of ASTM C840 or recommendations of gypsum board manufacturer whichever more stringent, for environmental conditions before, during and after application of gypsum board.

B. Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 degrees F. Do not exceed 95 degrees F when using temporary heat sources.

C. Ventilation: Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent finishing materials from drying too rapidly.

D. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

1. If Contractor chooses to install gypsum panels before areas are enclosed and conditioned, he does so entirely at his own risk. Damaged panels shall be removed and new panels installed at Contractor's expense and will not be deemed cause for additional time.

E. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

F. Provide adequate lighting and ventilation during installation and joint finishing treatment.

1.11 COORDINATION

A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 – PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include those listed under gypsum board products:

1. Manufacturers:

a. United States Gypsum Company (USG)
b. National Gypsum Company, LLC
c. CertainTeed Gypsum Corp
d. Georgia-Pacific Gypsum

B. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.02 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory" and GA-600, "Fire Resistance Design Manual".

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.

1. Design Loads: Engineer to withstand design loads including but not limited to gravity, wind, seismic, and erection design loads established by authorities having jurisdiction, applicable local building codes, and as indicated.
2. Structural Movement: Engineer to withstand movements of structure including, but not limited to, drift, twist, column shortening, long-term creep and deflection from uniformly distributed and

concentrated live loads. Contractor shall obtain required design data and identify movements accommodated on submittal drawings.

a. Accommodate plus or minus 3/8 in (10 mm) differential vertical deflection of floors.

D. Dimensional Tolerances: Engineer products and systems to accommodate dimensional tolerances of framing members and adjacent construction.

2.03 GYPSUM BOARD PRODUCTS

A. Sizes: Maximum lengths and widths available that will minimize short edge-to-short edge butt joints and to correspond to support system indicated.

B. Typical Paper-Faced Gypsum Board Products:

1. Paper-Faced Type X Gypsum Board:

a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
b. Description: Noncombustible fire-resistant gypsum core with paper surfacing on face, back, and long edges; tapered long edges; 5/8 in. thick.
c. Manufacturers and Products:

1) United States Gypsum Company (USG); Sheetrock Firecode X Gypsum Panels, or Sheetrock Brand EcoSmart Firecode X Panels.
2) National Gypsum Company, LLC; Gold Bond Fire-Shield Gypsum board.
3) CertainTeed Corporation; Type X Drywall Panel.
4) Georgia-Pacific Gypsum LLC; ToughRock Fireguard X Gypsum Board.

2. Abuse-Resistant Paper-Faced Gypsum Board:

a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
b. Description: Specially formulated, noncombustible, gypsum core with heavy liner paper on back and smooth, heavy abrasive-resistant face paper on face and long edges; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; 5/8 in thick.
c. Manufacturers and Products:

1) United States Gypsum Company (USG); Sheetrock Brand AR Firecode X Panels or Sheetrock Brand Glass-Mat Panels Mold Tough AR Firecode® X.
2) National Gypsum Company; Gold Bond XP Hi-Abuse Gypsum Board.
3) CertainTeed Corporation; Extreme Abuse Resistant Drywall.
4) Georgia-Pacific DensArnor Plus Fireguard Abuse-Resistant Interior Panels.

3. Impact-Resistant Gypsum Wallboard: ASTM C1396 and ASTM C 1629, manufactured to produce greater resistance to through-penetration than standard, regular-type and Type X gypsum board.

a. Description:

1) Core: 5/8 inch, Type X with additives to enhance fire resistance, surface indentation resistance and impact resistance, moisture and mold resistance.
2) Surface Abrasion: ASTM C1629, abrasion resistant, 100% recycled content moisture/mold/mildew resistant paper on front, back and long edges.
3) Embedded fiberglass mesh.
4) Long Edges: Tapered

b. Panel Physical Characteristics:

1) Surface Abrasion (ASTM C1629), meets or exceeds Level 2.
2) Surface Indentation (ASTM C1629), meets or exceeds Level 1.
3) Soft Body Impact (ASTM C1629), meets or exceeds Level 3.
4) Hard Body Impact (ASTM C1629), meets or exceeds Level 3.
5) Mold and Mildew Resistance: Panel score of 10, when tested in accordance with ASTM D3273.

c. Manufacturers and Products:

1) United States Gypsum Company (USG); Sheetrock Mold-Tough VHI Firecode X Gypsum Board.

2) National Gypsum Company; Gold Bond Hi-Impact XP Gypsum board.
3) Georgia-Pacific Gypsum LLC; DensArmor Plus Fireguard Impact-Resistant Interior Panel Gypsum Board.
4) CertainTeed Corporation; AirRenew Extreme Impact Resistant Drywall.

C. Moisture-Resistant Gypsum Board Products:

1. Moisture-Resistant Paper-Faced Gypsum Board:

a. Material Quality Standard: ASTM C 1396, Type X.
b. Description: Enhanced moisture-resistant, noncombustible gypsum core, with moisture-resistant paper surfacing on face, back and long edges; tapered long edges; score of 10 according to ASTM D 3273; 5/8 in. thick.
c. UL Type Designation: “SCX”
d. Manufacturers and Products:

1) United States Gypsum Company (USG); Sheetrock Brand Mold Tough Panels Firecode X or Sheetrock Brand EcoSmart Mold Tough Firecode X Panels.
2) National Gypsum Company; Gold Bond XP Gypsum Board.
3) CertainTeed Corporation; ProRoc Moisture and Mold Resistant Type X Gypsum Board.
4) Georgia-Pacific Gypsum LLC; ToughRock Fireguard X Mold-Guard Gypsum Board.

2.04 TILE BACKING PANELS

A. Cementitious Backer Panel:

1. Backerboard Panel Physical Characteristics: Panel complies with requirements of ASTM C 1325, ANSI A118.9 and ANSI A108.11 and as follows:

a. Thickness: As indicated.
b. Core: Cementitious, water-durable
c. Surface: Cement reinforced with fiberglass mesh on front and back
d. Long Edges: Tapered
e. Maximum available lengths to minimize end-to-end butt joints, square cut ends, tapered edge.
f. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
g. Density: 57 lbs. per cu. ft.

2. Acceptable Products:

a. USG Corporation; USG Durock Cement Board.
b. National Gypsum Company; PermaBase Cement Board.
c. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
d. Custom Building Products; Wonderboard
e. FinPan, Inc.; ProTEC Concrete Backer Board

B. Fasteners: ASTM C1002, USG Type “S” Bugle head screws for metal framing, manufacturer’s recommended length for panel thickness indicated..

2.05 TRIM ACCESSORIES

A. Paper Faced Metal Trim: Trim members conforming with ASTM C 1047 is required. Provide galvanized steel laminated with paper trim designed for concealed metal and for application without mechanical fastening, unless otherwise specified; sizes compatible with thickness of drywall.

B. Typical Drywall Trim Accessories:

1. Material Quality Standard: ASTM C 1047.
2. Description: Trim profile fabricated of paper-faced galvanized or aluminum-coated steel sheet; of required size for gypsum board thickness.
3. Manufacturers:

a. United States Gypsum Company (USG)
b. MarinoWare
c. Phillips Manufacturing.

d. ClarkDietrich Industries, Inc.

4. Trim Products:

a. Cornerbead:

1) Purpose: For protecting outside (external) and inside corners.
2) Basis of Design: ClarkDietrich Paper-Faced Corner Bead and Paper-Faced Inside Corner Bead.

b. L-Trim:

1) Purpose: For protecting exposed edges of gypsum board where gypsum board terminates.
2) Basis of Design: ClarkDietrich Paper-Faced L-Trim.

c. Control Joint:

1) Description: One-piece trim formed with V-shaped slot, with removable strip covering slot opening.
2) Purpose: For conditions requiring expansion and contraction stresses of large areas of gypsum board to be relieved.
3) Basis of Design: ClarkDietrich 093 Zinc Control Joint.

a) ClarkDietrich FAS-093X Fire Rated Control Joint where required.

2.06 FASTENERS

A. Limitations: Nails and staples are not permitted.

B. Metal Framing Screws: Screw fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten metal framing and furring members securely to substrates involved; complying with recommendations of gypsum board manufacturers for applications indicated.

C. Gypsum Board Screws:

1. Material Quality Standards:

a. Metal Framing Members less than 0.03 in (0.75 mm) Thick: ASTM C 1002, Type S.
b. Metal Framing Members from 0.033 in to 0.112 in (0.79 mm to 2.9 mm) Thick: ASTM C 954, Type S-12.

2. Product Description - Standard Applications: Bugle head, self-drilling, self-tapping, steel screws with Phillips-head recess of size, holding power, and other properties recommended by respective gypsum board manufacturer; minimum 1 in (25 mm) long; with corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
3. Product Description - High Moisture / Humidity Applications: Bugle head, self-drilling, self-tapping, stainless steel screws with Phillips-head recess of size, holding power, and other properties recommended by respective gypsum board manufacturer; for use at high moisture areas such as Kitchens, Showers and Tub Enclosures, Saunas, Steam Rooms, and Pool Enclosures.

D. Miscellaneous Fasteners: For conditions not indicated, fasteners shall be type, finish, size, and holding power recommended by respective gypsum board manufacturer and conditions.

2.07 JOINT TREATMENT MATERIALS

A. Joint Compound: ASTM C475, board manufacturer's standard ready-mixed, low-VOC joint compounds with no detectable amounts of crystalline silica based on NIOSH Method 7500.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use drying-type, all-purpose joint compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose joint compound.

D. Setting Type Joint Compound for Gypsum Board: Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated.

1. Where setting-type joint compounds are indicated as a taping compound only or for taping and filling only, use formulation that is compatible with other joint compounds applied over it.
2. For pre-filling gypsum board joints, use formulation recommended by gypsum board manufacturer.
3. For topping compound, use sandable formulation.

E. Drying-Type Joint Compounds: Factory-prepackaged vinyl-based products complying with the following requirements for formulation and intended use.

1. Ready-Mix Formulation: Factory-premixed product.
2. Taping compound formulated for embedding tape and for first coat over fasteners and flanges of corner beads and edge trim.
3. Topping compound formulated for fill (second) and finish (third) coats.
4. Lightweight Joint Compound: Specifically formulated to reduce airborne dust while sanding.

    a. Basis of Design: ProForm Lite Ready Mix Joint Compound with Dust-Tech as manufactured by National Gypsum, or equal products of the other named manufacturers.

F. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.
3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting- type, sandable topping compound.

2.08 SOUND ATTENUATION INSULATION

A. Sound Attenuation Batts: Glass or other inorganic fibers and resinous binders formed into flexible batts or blankets, complying with ASTM C665, Type I unfaced, manufacturer's standard sizes, thickness as indicated; lengths and widths required to interface with size of space insulated, maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, passing ASTM E 136 for combustion characteristics; and of the following nominal density and thermal resistivity:

B. Fiberglass Sound Attenuation Blankets:

1. Material Quality Standard: ASTM C 665, Type I.
2. Description: Unfaced blankets produced by bonding inorganic glass fibers with a thermosetting binder.
3. Surface Burning Characteristics: According to ASTM E 84/NFPA 255/UL 723:

    a. Flame Spread: Class A no greater than 25.
    b. Smoke Developed: No greater than 50.

4. Thickness: Not less than 2-1/2 in (62 mm), unless otherwise indicated.
5. Manufacturers and Products:

    a. CertainTeed Corporation; CertaPro AcoustaTherm Batts.
    b. Johns Manville Building Insulation Div.; Sound Control Batts.
    c. Knauf Fiber Glass; QuietTherm.
    d. Owens Corning; Sound Attenuation Batts.

C. Mineral Wool Sound Attenuation Blankets**:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide ROCKWOOL (Roxul, Inc.); Safe'n'Sound or comparable product by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. Thermafiber, Inc.; an Owens Corning company.

2. Nominal Density: 2.4 lb/cu. ft.

3. Thermal Resistivity: Not less than 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F
4. Flame-Spread Index: Not more than zero when tested in accordance with ASTM E84.
5. Smoke-Developed Index: Not more than zero when tested in accordance with ASTM E84.
6. UL Classification Code: BZJZ

D. Acoustical Sealant for Non-Fire Resistance Rated Joints:

1. Description: Nonsag, nonstaining latex sealant complying with ASTM C 834 that is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90.
2. Acceptable manufacturers and products:

a. Hilti Inc.; CP 506 Acoustical Sealant and CP 572 Acoustical Spray
b. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
c. United States Gypsum Company (USG); Sheetrock Acoustical Sealant.

2.09 RELATED MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Acoustical Joint Sealant: At acoustically rated assemblies, comply Section 07 92 00, "Acoustical Joint Sealants."

D. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033- to 0.112-inch thick.
2. For fastening cementitious backer units use screws of type and size recommended by panel manufacturer:

a. PermaBase Cement Board drill point screws (No. 8)

1) Wafer head, corrosion-resistant
2) Overall Thickness: 1-1/4 inch
3) For use with 20 to 14 ga. Steel framing and complying with ASTM C 1002

E. Backer Plates: 54 mil uncoated metal thickness steel sheet, galvanized, ASTM A525, G60.

1. Length: Sufficient to extend to nearest studs beyond maximum dimension of attached item and engage fasteners from attached item; span minimum three studs.
2. Height: 6 inch minimum or higher where required to accommodate item being fastened.
3. When manufacturer of attached item has more rigorous mounting plate requirements, comply with manufacturer's requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

1. Verify rough-in utilities and blocking is in proper position.

B. Do not proceed with installation until deficiencies are corrected and surfaces to receive gypsum board are acceptable.

C. Protrusions of framing, twisted framing members, or unaligned members must be repaired before installation of gypsum board is started.

3.02 PREPARATION

A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

B. Suspended Gypsum Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hanger wires at spacing required to support ceilings and that hangers will develop their full strength.

C. Items Which Require Backer Plates or Blocking: Coordinate sizes and locations.

1. Install additional studs for attachment of backer plates and blocking in required locations to receive surface mounted accessories as indicated or as required by accessory manufacturer.
2. Elimination of backer plates and blocking is not permitted.
3. Direct attachment of items to studs is not permitted.

3.03 INSTALLATION – ACOUSTICAL INSULATION

A. STC-Rated Assemblies: Comply with requirements of indicated Gypsum Association or other assembly designs.

B. Do not install sound attenuation blankets until mechanical and electrical work within framing spaces is complete.

C. Install sound attenuation blanket in contact with one face of partitions scheduled to receive sound insulation. Install insulation with daubs of adhesive applied to back of gypsum board or with adhesive applied to edge of studs to maintain full coverage and prevent slumping at tops of partitions and other displacement.. Sound insulated partitions shall be constructed, insulated and caulked so as to produce sound transmission coefficient rating (STC) indicated. Do not locate outlets, switches or similar items on opposing sides of partition within same stud space.

D. Fit sound attenuation blankets tight around cut openings and penetrations, and behind and around electrical and mechanical items within framing spaces. Pack blankets around door and window frames, between jamb studs, in boxed headers, and in other voids.

3.04 INSTALLING ACOUSTICAL SEALANTS

A. Comply with ASTM C919 and manufacturer's recommendations for location of acoustical sealant beads, and close off sound-flanking paths around or through the work, including sealing of partitions above acoustical ceilings.

B. Provide continuous bead of sealant under bottom edge of gypsum board and wall cut outs, at toilet room partitions and other partitions receiving sound insulation so as to completely seal wall against sound leaks.

C. Apply 3/8 inch continuous bead of acoustical sealant to face of runner tracks before applying gypsum boards; completely seal wall against sound leaks.

D. Where sound attenuation blankets are installed in partitions, seal perimeters, control and expansion joints, openings, and penetrations with continuous beads of acoustical sealant at both faces of partition.

1. Apply acoustical seals to electrical boxes and other penetrations of gypsum board.

E. Do not allow acoustical sealant to remain exposed to air for more than 15 minutes before panel is applied.

F. Completely seal around perimeter of and penetrations through sound walls, including intersections with walls, columns, and other adjacent construction; fill depth of gaps around gypsum panels at floor, structure above, door frames, and other openings; and at cutouts for electrical boxes, pipes and plumbing, and other penetrations. Cut panels accurately to fit penetrations. Caulk openings in non-fire rated partitions with acoustical sealant.

G. Putty Pads:

1. Before installing wallboards, install putty pads in accordance with manufacturer's written instructions.

2. Overlap front edge of box so that putty will be compressed around edges of box as gypsum panels are installed.
3. Applications:
    a. Electrical boxes in fire barriers, smoke barriers, and STC-rated walls.
    b. Electrical boxes at interior gypsum board faces of exterior walls.

3.05 REPAIR WORK AT EXISTING GYPSUM BOARD SYSTEMS

A. Prepare all openings indicated on drawings to be removed in existing work to permit access for new work.

B. Cut back existing gypsum board to rectangular shape for opening to the nearest stud or blocking. Provide supplementary metal framing to support edges of gypsum board on all sides of openings.

C. Remove all existing trim pieces, tape and joint filler that will interface with providing a smooth surface in the new work.

D. Infill openings with metal stud framing where the opening size exceeds the stud spacing established elsewhere in this section. Set new studs so as to allow the finished face of the new gypsum board to be flush and even with the existing. For ceiling assemblies, provide additional framing to support new gypsum board infill.

E. Install and finish new gypsum board to be smooth and flush with existing work, such that infill will be unnoticeable in finished condition.

F. On walls which are decorated with vinyl wall covering, peel back covering to allow for gypsum board patching. Re-apply covering at completion of gypsum board work.

G. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including nondecorated surfaces.

H. Patch holes or openings 1/2 inch or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.

I. Repair holes or openings over 1/2 inch diameter, or equivalent size, with 5/8 inch thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.

J. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non-decorated surface to provide continuity of surface and such that defect is not visible when painted is completed.

3.06 INSTALLATION, GENERAL

A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

1. United States Gypsum Company (USG); Gypsum Construction Handbook, if no other installation quality standard applies to condition.
2. Respective Manufacturer’s written installation instructions.
3. Accepted submittals.
4. Contract Documents.
5. Gypsum Association GA 216.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.07 INSTALLATION OF GYPSUM BOARD ASSEMBLIES

A. Gypsum Board Installation Requirements: Comply with ASTM C840.

1. Do not proceed with gypsum board installation until blocking, framing, bracing, and other supports for subsequently applied work have been reviewed, installed, and accepted by the Architect.
2. Do not install gypsum board until thermal and acoustical insulation, membrane vapor barriers, and other work concealed by gypsum board have been installed.

B. Resistance Rated Partitions: Construct fire resistance rated, smoke resistance rated, and sound resistance rated partitions according to respective assembly test reports. Ensure every material used within an

assembly shall comply with manufacturers listed and product qualities indicated in respective assembly test report.

C. Acoustically Rated Partitions:

1. Verify that resilient channels where required are installed properly.
2. Install gypsum board with long dimension parallel to resilient channels and end joints staggered. Allow 1⁄8 inch spacing between the ceiling perimeter and adjacent walls and fill with acoustical sealant. Attach gypsum board with screws at recommended spacing along channels. Do not to fasten gypsum board through the channel into wood joists. Joints between boards should be centered over the resilient channels, or be midway between channels with joints floated and backed with sections of channels. Provide 3-mm (1⁄8-in.) spacing between the edges of boards, floor, and adjacent walls, and to fill space with acoustical sealant.

D. Control Joints: Install control joints at locations indicated on Drawings, in specific locations approved by Architect for visual effect and according to the following:

1. Spaced not more than 30 feet in either direction for uninterrupted straight planes of ceilings and walls.
2. Where different substrates occur at ceilings and walls.
3. Where control joints occur in substrates at ceilings and walls.
4. Where ceilings and walls abut inside face of exterior walls.
5. Where L, U, or T shaped ceiling configurations are joined.
6. Where less-than-ceiling-height door frames occur on walls more than 30 feet in length; extend control joints from top of frame up to ceiling at corner of hinge side of door
7. Where less-than-ceiling-height borrowed lites occur on walls more than 30 feet in length; extend control joints from top of frame up to ceiling and from bottom of frame to floor at both corners.

E. Isolation from Building Structure: Isolate gypsum board assemblies from building structure to prevent transfer of loading imposed by structural movement.

1. Provide isolation joints as indicated or required by installation quality standards.
2. Isolate ceiling assemblies abutting or penetrated by building structure.
3. Isolate partition framing and wall furring abutting or penetrated by building structure, except at floor.

F. Supplemental Accessories: Install supplementary framing, blocking, reinforcing, and bracing in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, hand rails, furnishings, or similar construction. Comply with details indicated and recommendations of installation quality standards or manufacturer.

3.08 INSTALLATION OF CEMENT BOARD

A. Tile Backing Panels

1. Cementitious Backer Units: ANSI A108.11, at locations indicated.
2. Areas Not Subject to Wetting: Install Moisture and Mold Resistant gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive cementitious backer units.
3. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.
4. Precut panels to required sizes and treat necessary edges at penetrations, joints, and intersections before panel installation with Sheetrock W/R compound. Treat all fastener heads with Sheetrock W/R compound after installation. Fill all openings around pipes, fittings, and fixtures with Sheetrock W/R compound before ceramic tile installation.
5. Space fasteners maximum 8 in. o.c. for walls, 6 in. o.c. for ceilings, with perimeter fasteners dimension per manufacturer’s instruction. Drive screws so bottoms of heads are flush with panel surface to ensure firm panel contact with framing. Do not overdrive fasteners.
6. Manufacturer recommended tile backer screws for steel framing or wood framing per project conditions.
7. Prefill joints with tile-setting mortar or adhesive and then immediately embed tile backer tape and level joints.
8. If waterproofing is required to be applied to panels per Division 09 Section “Tiling,” confirm approved product with tile backing panel manufacturer.

3.09 INSTALLING GYPSUM BOARD PRODUCTS

A. General Requirements:

1. Install type of gypsum board at location indicated by gypsum board schedule at end of this Section.
2. Do not install damaged gypsum boards.
3. Install gypsum boards with finishable face side out.
4. Butt gypsum boards together for a light contact at edges and ends with not more than 1/16 in (1.5 mm) of open space between panels.
5. Do not force gypsum boards into place.
6. Do not place tapered edges against cut edges or ends.

B. Isolation from Building Structure and Window and Door Frames:

1. Apply edge trim where gypsum board abuts dissimilar materials.
2. Provide 1/4 in to 1/2 in (6 mm in 12 mm) wide spaces at these locations and trim edges with edge trim where edges of gypsum boards are exposed.
3. Seal interior joints between edge trim and abutting structural surfaces with acoustical sealant.

C. Single-Layer Board Assemblies:

1. At typical conditions, install gypsum board vertically (long dimension parallel to metal framing), to minimize short end-to-short end joints unless otherwise indicated or required by assembly fire test reports.
2. At interior of stairwells and other high walls, install gypsum boards horizontally, unless otherwise indicated or required by assembly fire test reports. Stagger abutting end joints not less than one framing member in alternate courses of gypsum boards.

D. Multi-Layer Board Assemblies: Apply base layers and face layers vertically (long dimension parallel to metal framing) with joints of base layers located over stud or furring member and face layer joints offset at least one stud space from base layer joints, unless otherwise indicated or required by assembly fire test reports. Stagger joints on opposite sides of partitions.

E. Ceiling Applications:

1. Apply gypsum board at right angles to main beams of suspension framing to minimize number of abutting end joints and avoid abutting end joints in central area of each ceiling.
2. Stagger abutting end joints of adjacent panels not less than one framing member.
3. Locate both edge or end joints of gypsum boards over intermediate supports or gypsum board back-blocking where metal framing is not present.

F. Typical Wall Applications:

1. Attach gypsum boards to metal studs so that leading edge or end of each board is attached to open (unsupported) edges of stud flanges first.
2. Stagger vertical joints on opposite sides of partitions.
3. Do not make joints other than control joints at corners of framed openings.
4. Attach gypsum boards to framing provided at doors, windows, other openings and cutouts. Avoid gypsum board joints within 12 in. of the corners of these openings.
5. Cut gypsum board to allow for a minimum 1/4 in. gap between gypsum board and floor to prevent potential wicking of moisture.
6. Cover both faces of metal framing with gypsum boards as indicated, except in chase walls that are braced internally.
7. Cut and fit gypsum boards around ducts, pipes, conduits, and other penetrations to form proper annular joint.
8. Where partitions intersect open building structure members projecting below underside of floor slabs and roof decks, cut to fit profile formed by coffers, joists, beams, and other structural members; form proper annular joint.
9. Support both edge and end joints of gypsum boards over metal framing.

G. Screw Attachments:

1. Attach gypsum board to metal framing with screw fasteners of type appropriate for gypsum board materials and installation conditions:

    a. Length shall be as required by condition and penetrating metal framing not less than 3/8 in (10 mm).

b. Spacing shall be as recommended by installation quality standard, gypsum board manufacturer, or respective assembly test report.
c. Use properly adjusted, positive-clutch electric power tool equipped with adjustable screw-depth head and a Phillips bit. Nails and staples are not permitted.

2. Drive screws to slightly dimple surface without breaking face paper, fracturing core, or stripping metal framing member around screw shank.
3. Space screws for non-fire resistance rated partitions and ceilings as recommended by installation quality standards.
4. Start field screwing near center and work towards edges.
5. Space screws not less than 3/8 in (10 mm) from gypsum boards edges.
6. Do not attach gypsum boards to top runner where wall or partition extends to building structure unless required by fire test reports.

H. Control Joints: Form control joints and expansion joints at locations indicated with required space between edges of adjoining gypsum boards.

I. Sound Attenuation Blankets: Install blankets within stud cavities set so that they are held in place by friction with metal studs; ensure blankets are secure within cavity and will not become displaced when second gypsum board side is closed.

J. Sealant:

1. Seal wall assemblies at perimeters, behind control joints, and at openings and penetrations with a continuous bead of sealant material according to following:

a. Water Resistance Sealant: Joints within non-fire resistance rated assemblies exposed to possible water infiltration.
b. Acoustical Sealant: All other joints.

3.10 INSTALLING TRIM ACCESSORIES

A. Attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840.

1. Install double studs to create control joints, leave 1/2 inch separation between gypsum board panels for installation of control joint units.
3. Routing gypsum board to create joint is not acceptable.

C. Control Joint Locations: Where indicated, but not less than the following.

1. Locations of control and expansion joints in substrate or framing.
2. Walls: Maximum 30 ft o/c; coordinate locations with Architect. Wall or partition-height door frames may be considered as control joints.
3. Ceilings: In ceilings larger than 2500 square feet, locate control joints maximum 50 feet on center each way, and at all locations where framing or furring change direction. Coordinate locations with Architect.
4. Joints between different types of gypsum board in same plane.

D. Interior Trim:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. Curved-Edge Cornerbead: Use at curved openings.

E. Exterior Trim:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

F. Cornerbead: Install in single pieces at vertical corners.

G. Edge Trim: Install where edge of gypsum board would otherwise be exposed or semi-exposed.

1. Install trim in a single piece on each side of opening perimeters with joints only at corners. If size of opening exceeds available length of edge trim, coordinate locations of joints with Architect.

H. Reveals: Install trim plumb, level, accurately aligned, and fitted neatly with hairline joints.

1. Cut trim with sharp power saw and file cut edges to remove burrs.
2. Miter joint at changes in direction or plane, except that inside corners may be coped.
3. Apply masking tape or other protection to reveal surfaces before starting drywall finishing to keep surfaces clean and free of finishing compound and other substances.
4. Routing gypsum board to create reveal is not acceptable.

3.11 FINISHING GYPSUM BOARD PRODUCTS

A. General: Treat board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare surfaces for decoration.

B. Joint Tape: Finish joints according to following:

1. Typical Paper-Faced Gypsum Board: Paper.
2. Moisture-Resistant Paper-Faced Gypsum Board: Mesh tape.

C. Finishing: Finish boards and units to achieve specified level of finish as indicted in schedule at end of section.

1. Typical Paper-Faced Gypsum Board: Either or combination of the following as recommended by manufacturer:

   a. Setting-type joint compounds.
   b. Drying-type joint compounds.

2. Moisture-Resistant Paper-Faced Gypsum Board: Setting-type joint compounds.

3.12 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Manufacturer’s qualified technical representative shall inspect first day’s Work and periodically inspect Work to ensure installation is proceeding in accordance with manufacturer’s designs, recommendations, and instructions. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.

3.13 ADJUSTMENTS

A. Damaged Materials: Stored or installed paper-faced gypsum board materials not specifically manufactured as “moisture-resistant products” shall be classified as damaged, defective, and nonconforming Work if they have been exposed to wetness or dampness at any time prior to Substantial Completion or if they exhibit evidence of active or dormant mold or mildew. Damaged materials and assemblies shall be replaced with new and dry materials and assemblies.

3.14 PROTECTION

A. Procedures: Protect products and systems from damage during installation and remainder of construction period according to manufacturer's instructions.

3.15 GYPSUM BOARD SCHEDULE

A. Gypsum Board Schedule, General: Install the designated gypsum board product based on exposure classification to water and / or moisture and applied finish system as follows, unless otherwise indicated or scheduled on the Drawings.

B. No Exposure: Surfaces not normally exposed to water and / or moisture sources including but not limited to the following:

1. Typical walls and ceilings.

   a. Paint and Wall Coverings Only: Typical paper-faced gypsum board.
   b. Tile and Adhered Sheet/Panel Coverings: Moisture-resistant coated-glass-mat gypsum board.

2. Abuse-resistant walls as indicated in the Drawings:

   a. Paint and Wall Coverings Only: Abuse-resistant paper-faced gypsum board.

C. Incidental Exposure: Surfaces immediately adjacent to water and / or moisture sources including, but not limited to, the following locations:

1. Top of walls above ceilings adjacent to mechanical equipment in corridors.
2. Walls and ceilings in mechanical equipment rooms and janitor closets.
3. Walls within 24 inches of centerline of drinking fountains, isolated wall-hung lavatories, and countertop sinks and other similar water sources.
4. Interior face of exterior walls.
5. Acceptable gypsum board products for the above listed conditions:

    a. Paint and Wall Coverings: Moisture-resistant paper-faced or moisture-resistant paperless glass-mat gypsum board.
    b. Tile and Adhered Sheet/Panel Coverings: Moisture-resistant coated-glass-mat gypsum board.

D. Direct Exposure: Surfaces normally soaked, saturated, or regularly and frequently exposed to water and / or moisture including, but not limited to, the following locations:

1. Walls and ceilings in toilet rooms and bathrooms including bathtubs and showers:

    a. Paint and Wall Coverings: Moisture-resistant paper-faced or moisture-resistant paperless glass-mat gypsum board.
    b. Tile and Adhered Sheet/Panel Coverings: Moisture-resistant coated-glass-mat gypsum board.

3.16 GYPSUM BOARD FINISHING SCHEDULE

A. Gypsum Board Finishing Schedule, General: Finish panels to Levels of Finish indicated below. Apply joint tape over panel joints, except those with trim having flanges not intended for tape. Sand between coats and after last coat to produce a surface free of defects and ready for applied finish system.

B. Preparation: Apply joint compound at open joints, panel edges, and damaged surface areas.

C. Level 1: At following locations, embed tape at joints in joint compound unless a higher level of finish is required for fire resistance rated assemblies:

1. Ceiling plenum areas above ceilings.
2. Concealed areas.
3. Substrate for interior woodwork.

D. Level 2: At following locations, embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges:

1. Substrate for tiling.

E. Level 3: At following locations, embed tape and apply separate first and second coats of joint compound to tape, fasteners, and trim flanges:

1. Mechanical, electrical, data and elevator equipment rooms.

F. Level 4: At following locations, embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges:

1. Areas to receive paint with eggshell/satin sheen or light texture.
2. Areas to receive Type II vinyl wall coverings.
3. Areas to receive fabric wall coverings.

G. Level 5: At following locations, embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound or Level 5 Primer and Surfacer over entire surface:

1. Areas to receive lightweight Type I vinyl wall coverings.
2. Areas to receive un-backed vinyl wall coverings.
3. Areas where critical lighting conditions occur.
4. Areas as indicated on the Drawings.
5. Areas to receive applied graphics.

END OF SECTION

SECTION 09 30 13

TILING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes tile work for application to floor and wall surfaces and including accessories, and related items necessary to complete the Work indicated.

1. Porcelain wall tile
2. Porcelain floor tile
3. Cove base
4. Crack suppression membrane.
5. Setting bed, grout, and accessories for complete installation.

B. Related Sections include the following:

1. Section 03 30 00 – Cast in Place Concrete: Floor substrate.
2. Section 07 92 00 – Joint Sealants: For sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Section 09 29 00 – Gypsum Board for cementitious backer units installed as part of gypsum wallboard systems.

1.02 DEFINITIONS

A. Large Format Tiles (LFT): 8-inches x 8-inches or greater tile size.

1.03 PERFORMANCE REQUIREMENTS

A. General: Provide floor tiles complying with one of the following standard and performance requirements.

B. Dynamic Coefficient of Friction (DCOF): For tile installed on walkway surfaces, provide products with the following value as determined by testing identical products by the DCOF AcuTest Method per ANSI 137.1, 2019 Edition.

1. Walkway Surfaces: Minimum 0.42.

1.04 REFERENCES

A. American National Standards Institute (ANSI):

1. A108.1 - Ceramic Tile Installed with Portland Cement Mortar.
2. A108.5 - Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
3. A108.6 - Installation of Ceramic Tile with Chemical-Resistant, Water Cleanable Tile-Setting and Grouting Epoxy.
4. A108/A118/A136 – Specification for the Installation of Ceramic Tile.
5. A118.3 - Chemical Resistant Water Cleanable Tile-Setting and Grouting Epoxy.
6. A118.4 - Latex-Portland Cement Mortar.
7. A137.1 – Specifications for Ceramic Tile

B. American Society for Testing and Materials (ASTM):

1. C144 - Aggregate for Masonry Mortar.
2. C150 - Portland Cement.
3. C206 - Finishing Hydrated Lime.
4. C207 - Hydrated Lime for Masonry Purposes.

C. Tile Council of North America (TCNA):

1. Handbook of for Ceramic Tile Installation, current edition.

1.05 ACTION SUBMITTALS

A. Prepare submittals per requirements of Section 01 33 00 – Submittal Procedures.

B. Product data for each type of product specified.

C. Shop drawings indicating tile patterns and locations and widths of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

1. Locate precisely each joint and crack in tile substrates by measuring, record measurements on shop drawings, and coordinate them with tile joint locations, in consultation with Architect.

D. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual tiles or sections of tile showing full range of colors, textures, and patterns available for each type and composition of tile indicated. Include samples of grout and accessories involving color selection.

E. Samples for Verification: Of each item listed below, prepared on Sample of size and construction indicated. Where products involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. Each type and composition of tile and for each color and texture required, at least 12 inches square, mounted on braced cementitious backer units, and with grouted joints using product complying with specified requirements and approved for completed work in color or colors selected by Architect.

F. Grout Samples for Initial Selection: Manufacturer’s color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

G. Maintenance Guide: Submit, in duplicate the tile manufacturer’s maintenance instructions.

H. Manufacturer’s Certificate: Submit certificate indicating that the mortar, adhesive, and grout meet ANSI standards and are suitable for the proposed use.

I. Master Grade Certificate: Certification that the tile conforms to ANSI/TCNA A137.1 for standard grade tile for use on this specific work.

1.06 INFORMATIONAL SUBMITTALS

A. Test Reports: Submit test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile products with requirements specified for slip resistance.

B. Master Grade Certificates: Submit master grade certificates for each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: Submit manufacturer's certifications for each type of grout and bonding material being provided suitable for the intended use and meet or exceed the referenced standards and the requirements of this Specification.

1.07 QUALITY ASSURANCE

A. Pre-Installation Conference:

1. In accordance with Section 01 31 00, schedule and administer a meeting to review and discuss the tile installation a minimum of one week (7 calendar days) prior to start of setting tile.
2. Require in attendance, the Architect, the tile installer, and other parties affected by work of this Section.
3. Agenda: Address installation scheduling and procedures, coordination, preparation and protection requirements, grout and expansion joint locations, tile quantities required, material and installation tolerances, overage required for waste, overage for maintenance stock, sealant joint locations.

B. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

C. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.

D. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

E. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:

1. Crack isolation membrane.
2. Joint sealants.
3. Backer units.
4. Metal edge strips.

F. Field-Constructed Sample Installations: Before installing tile, erect sample installations for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build sample installations to comply with the following requirements, using materials indicated for final unit of Work.

1. Locate sample installations on site, in locations and size indicated or, if not shown or indicated, as directed by Architect but not less than 100 sq. ft. area for floors, and not less than 100 sq. ft. area for walls.
2. Retain and maintain sample installations during construction in undisturbed condition as a standard for judging completed unit of Work.
3. Approved sample installations may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer’s original sealed containers and as follows:

1. Labels legible and intact identifying brand name and contents.
2. Tile cartons grade-sealed by manufacturer in accordance with ANSI A137.1.
3. Grade-seals unbroken.
4. Manufactured mortars and grouts shall contain hallmarks certifying compliance with reference standards and are types recommended by tile manufacturer for application.

B. Deliver manufactured mortar and grout materials in sealed, moisture proof containers.

C. Store materials under cover in manner to prevent damage or contamination.

1.09 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

B. Provide minimum 28-day cure of concrete and concrete masonry units before the installation of the tile work.

C. Ensure cement and plaster rendering has been applied to interior concrete masonry wall surfaces and has been reviewed by the installer for suitability to receive his mortar bedding materials prior to installation of the tile work.

D. Maintain temperatures within range recommended by the mortar and grout manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C), in spaces during tile setting. After installation maintain temperatures within range recommended by the mortar and grout manufacturer

E. Close spaces to traffic during tile flooring installation.

F. Close spaces to traffic for 72 hours after tile flooring installation.

G. Shade all tile, materials and the work area from direct sunlight during the installation as needed to prevent rapid evaporation caused by excessive heat or wind.

PART 2 – PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers/fabricators offering products that may be incorporated into the Work include but are not limited to those listed below.

B. Tile basis of design products are indicated in the Schedule of Finishes on the drawings.

2.02 TILE PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI A137.1 "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Products and Manufacturers: Provide tile matching the Architect's samples which have been selected from the product lines and manufacturers indicated in the Schedule of Finishes.
2. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

B. Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing where applicable.

C. Rectified Tile Edges: Provide all tile units having a face dimension of greater than 8" x 8" with factory rectified edges.

2.03 TILE MATERIALS

A. Basis of Design: Setting and Grouting Materials:

1. Mapei Corp., Deerfield Beach, FL
2. Comparable Products: Subject to compliance with requirements, provide the “Basis of Design” product or a comparable product by one of the following:

    a. American Olean Tile Co., Dallas, TX
    b. Bonsal American (ProSpec), Charlotte, NC
    c. Custom Building Products, Huntington Beach, CA
    d. Dal-Tile Corp., Dallas, TX
    e. Laticrete International, Inc., Bethany, CT
    f. Bostik, Inc. Middleton, MA

B. Mortar and Thin Sets: Products of the following mortar manufacturer’s will be acceptable, providing their products equal or exceed the type and quality of the specified products.

1. Latex Portland Cement Mortar:

    a. Custom Building Products: PremiumPlus Premium Non-Modified Thin-Set Mortar
    b. Mapei: Keraset/Keraply
    c. Bostick: Tile-Mate 710/713/Hydroment 425
    d. Bonsal American: Floor Thin-set Mortar/B-730 Acrylic Additive
    e. C-Cure: 911 Thinset/939 Cure Crylic Premium
    f. Laticrete: Laticrete 317/Laticrete 3701 Grant & Mortar Admix
    g. TEC: Thin-set Mortar 335/336/Full Bond

2.04 SETTING AND GROUTING MATERIALS

A. Manufacturers and Plant Locations: Provide products manufactured in the plant closest to the geographic location of the project.

B. Source Limitations: For each tile installation, obtain compatible formulations of setting and grouting materials and waterproofing materials containing latex or latex additives from a single manufacturer.

C. Latex-Portland Cement Mortar (Thin Set):

1. Prepackaged dry-mortar mix combined with dry powder latex additive, one of the following:

    a. For Thin Set Placed over Slabs on Grade: ANSI A118.4 consisting of the following:

1) Versabond Flex; Custom Building Products.
2) Ultraflex 2 Mortar; MAPEI Corporation.
3) Laticrete 253 Gold; Laticrete International Inc.

b. For Thin Set Tile Set over Walls, Membranes and Over Elevated Slabs: ANSI A118.15 consisting of the following:

1) Porcelain Tile Professional Thin-Set Mortar, Custom Building Products.
2) Kerabond Keralastic; MAPEI Corporation.
3) Laticrete 272 mixed with Laticrete 333 Superflex; Laticrete International Inc.

2. For wall applications, provide nonsagging mortar.

D. Dry Set Mortar for Large and Heavy Tile (LHT Mortar): ANSI A118.4:

1. Prepackaged dry-mortar mix combined with additives to minimize slump and facilitate a thicker bond coat, and specifically manufactured and recommended in writing by the mortar and underlayment manufacturer for use in LHT mortar assemblies; one of the following:

a. VersaBond®-LFT Professional Large Format Tile Mortar, Custom Building Products.
b. Ultraflex LHT Mortar; MAPEI Corporation.
c. Laticrete LHT; Laticrete International Inc.

E. Polymer-Modified Tile Grout (For Typical Applications): ANSI A118.7 compounded with calcium aluminate cement, non-shrinking, efflorescence free grout.

1. Polymer Type: Dry, redispersible latex/polymer powder form, prepackaged with other dry ingredients, one of the following:

a. Prism; Custom Building Products.
b. Permacolor; Laticrete International Inc.
c. Ultracolor Plus FA; Mapei Corporation.

2. Colors: As selected by Architect from manufacturers standards to match tile being grouted.

2.05 ACCESSORY MATERIALS

A. Underlayment Product for Leveling and Patching Floors indicated to receive Tiles: Latex modified, cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

1. LevelQuik RS (Rapid Setting) Self-Leveling Underlayment, Custom Building Products.
2. Either Ultraplan or Novaplan Underlayment; MAPEI Corporation.
3. NXT Level Plus Underlayment; Laticrete International Inc.

B. Joint Sealants:

1. Typical Surfaces: "Mildew-Resistant Silicone Sealant', as specified in Section 07 92 00 "Joint Sealants."
2. Floor Joints (**Type HL2**): 'Two-Part Polyurethane Sealant for Paving Applications,' as specified in Section 07 92 00 – Joint Sealants. Minimum shore A harness of 35.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Grout Sealer: Grout manufacturers recommended product for sealing cementitious grout joints and that does not change color or appearance of grout.

E. Metal Edge Strips for Wall Applications: Metallic, angle or L-shaped, depth to match tile and setting-bed thickness and having an integral provision for anchorage to substrate; white zinc alloy exposed-edge material; furnish in longest lengths available.

1. Manufacturers: Provide products of one of the following:

a. Schluter Systems L.P.
b. Blanke Corporation.
c. Ceramic Tool Company, Inc.

F. Divider, Transition, and Movement Joint Strips:

1. Divider and Transition Strips: Stainless steel shapes and flat bar trims fabricated from ASTM A 666 (for flat bar) and ASTM A 276 (for shapes) Type 304 stainless steel, 1/4 inch wide at top edge unless otherwise indicated, depth as required to suit conditions shown and having an integral provision for anchorage to mortar bed or substrate, unless otherwise indicated. Provide NAAMM #4 satin finish at exposed top edge in the long direction, furnish in longest lengths available.
2. Movement Joint Strips: Laminations of extruded aluminum or formed stainless steel angle shapes, depth as required to finish flush with top surface of adjacent tile flooring fields, back to back installed with full height flexible filler to accommodate movement. Control joints shall have either an exposed approximately 5/8 inch wide interlocking continuous top to conceal prefabricated flexible filler or an exposed custom flexible prefabricated filler to accommodate movement. Joint assembly shall have a total movement capability of approximately 1/4 +1/8 inch/-3/32 /inch. Finish of exposed top to be satin. One of the following:
    a. Basis of Design: Emseal Series ESF 16 AL; Emseal Joint Systems, Ltd.
    b. Schluter; Dilex - EDP, fabricated to comply with the specified requirements.
    c. CTC (Ceramic Tool Company); CTC Joint custom fabricated to comply with the specified requirements.
    d. Vexcolt; Ti-Lock Metal, TAM NL 42151 (for thickset) or TAM NA 1212 (for medium and thinset).

2.06 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions. Add materials and liquid latex additives in accurate proportions. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
    1. Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
    2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
        a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
        b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
    3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
    4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.
    5. Verify that cementitious backing board is installed in accordance with the manufacturer's installation instructions, firmly supported and fastened, and installed with fiberglass reinforcing tape at joints between panels completely embedded in thin-set mortar.
    6. Where cementitious tile backing board is indicated as substrate for wainscot, ensure that backing board has been properly shimmed to align with gypsum board above.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture test recommended by flooring manufacturer.
2. Subfloor Moisture Conditions: Before installing flooring Contractor shall verify that Moisture emission rate of not more than 3 lb/1000 sq. ft./24 hours when tested by calcium chloride moisture test in compliance with CRI 104, 6.2.1 and does not exceed the capacity of the specified adhesive or mortar, with subfloor temperatures not less than 55 deg F, or as recommended by manufacturer.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Prior to laying flooring, vacuum and remove all contaminates from surfaces to be covered and inspect subfloor. Start of flooring installation indicates acceptance of subfloor conditions and full responsibility for completed work. Use leveling compound as recommended by flooring manufacturer for filling small cracks and depressions in subfloors.

D. Provide concrete substrates for tile floors installed with dry-set or latex-portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.

1. Underlayment: Eliminate deviations in floor flatness and level as necessary for installation of large format tile.
2. Use trowelable leveling and patching compounds in accordance with tile-setting material manufacturer’s written instructions to fill cracks, holes, and depressions.
3. Remove protrusions, bumps, and ridges by sanding or grinding.

E. Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.03 SLAB LEVELING

A. Prior to installation of thinset floor tile, where local irregularities in the substrate surface would prevent level installation of the tile, the substrate shall be brought to plane surface with variations not to exceed 1/8 inch in 4 feet (cumulative) and 1/4 inch in 10 feet (non-cumulative). Smooth abrupt changes in plane.

B. Use thinset mortar or other filler for slab leveling. Other fillers are subject to endorsement by the setting mortar manufacturer. Submit manufacturer's letter of approval to the Architect.

C. Screed or float to appropriate thickness and specified surface tolerance. Allow to set prior to proceeding with installation. Do not exceed the maximum thicknesses for thin bed mortar as recommended by the manufacturer.

3.04 CRACK ISOLATION MEMBRANE INSTALLATION

A. Provide crack isolation membrane at following locations:

1. At control and construction joints in concrete floors.
2. At changes in substrate materials.
3. Surfaces of suspended slabs minimum 15 inches each side of building column grid lines (total of 30 inches, minimum).
4. On each side of building floor joint cover assemblies installed in grouted pockets; extend a minimum of 12 inches beyond grouted pocket.
5. Shrinkage cracks 1/16 inch or larger in slabs as directed by the Architect.

B. Extend a minimum of 12 inches each side of crack or joint.

C. Do not apply crack isolation membrane at joints which will be reflected as expansion joints in the tile.

D. Substrate Examination:

1. Substrates are subject to examination by the Owner and the Architect prior to installation of tile or slab leveling materials. Furnish a minimum of 7 days’ notice.
2. The examination will determine the need for additional crack isolation membrane at shrinkage cracks and other special conditions.

3. Provide additional crack isolation membrane in locations as directed, up to the minimum quantity specified.

E. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

F. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.05 INSTALLATION – GENERAL

A. Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" and the TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" that apply to types of setting and grouting materials and to methods indicated.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Jointing Pattern: Lay tile in pattern indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area beginning at thresholds. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.

E. Finished Surfaces: Unless otherwise accepted in the sample installation(s), if any, finished surfaces shall present a flat, even appearance, free from waver, projections, and depressions.

F. Movement (Contraction, Control, Expansion, and Isolation Joints) Joints: Locate sealant filled movement joints where recommended by the manufacturer of mortar and grout materials, but not less than the requirements of TCNA EJ171 which follows, and as accepted by the Architect. Form movement joints and other sealant-filled joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles. Where movement joints are to be butted, the ends shall touch and align.

1. Spacing Guidelines:

a. 20 to 25 feet in each direction where interior tile work is not exposed to direct sunlight or moisture.
b. 8 to 12 feet in each direction where interior tile work is exposed to direct sunlight and moisture.
c. Where tilework abuts restraining surfaces such as perimeter walls, dissimilar floors, curbs, columns, pipes, ceilings, and where changes occur in backing materials, but not at drain strainers.
d. In the joint between tiles making up the inside corner of planes.
e. All contraction, control, expansion, isolation, seismic and cold joints in the horizontal structure and vertical surfaces shall continue through the tile surfaces, but not through membranes.
f. Vertical and Horizontal Joints Widths: Widths for quarry tile and paver tile shall be the same as the grout joint but not less than 1/4 inch or the width of the contraction, control, expansion, seismic, isolation joint whichever is greater; widths for ceramic mosaic tile and glazed wall tile shall not be less than 1/8 inch or the width of the control, expansion, seismic, joint whichever is greater.
g. Keep movement joints free from dirt, debris, grout, mortar, and setting bed materials. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

G. Metal Edge Strips: Install where exposed edge of wall tile meets, terminates, or overlays other wall finishes that finish flush with or below face of the tile, and the manufacturer of the field tile does not manufacture a tile edge transition trim. Provide metal edge strips as full length single units. Miter corners and smooth sharp edges.

H. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout sealer manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.06 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

1. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.07 FLOOR TILE INSTALLATION

A. Thinset Tile over Concrete Slabs (Typical): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.
2. Concrete Subfloors, Interior: TCNA F113 with crack isolation membrane.
    a. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.
    b. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
    c. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch.
    d. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponge. Rake out joints to depth required to receive grout as tile units are set.
    e. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. For typical installations, comply with latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

B. Thinset Tile over Crack Isolation Membrane: Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.
2. Concrete Subfloors, Interior: TCNA F125-Full.
    a. Apply the mortar to crack isolation membrane covered slab with the flat side of the trowel.
    b. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.
    c. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
    d. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch.
    e. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set.

f. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.

3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

C. LHT Set Tile (for Large Format Tile): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.
2. Concrete Subfloors, Interior: TCNA F205 (on-ground slabs) and TCNA F205A (above ground slabs) except apply LHT bed in thickness recommended by the manufacturer.

a. Where required by the conditions indicated, apply underlayment using methods and within time limits recommended by the mortar manufacturer.
b. With a trowel, having notches sized as recommended by the mortar manufacturer, place and comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturers recommendations.
c. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
d. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100% coverage to thickness of not less than 1/16-inch (1.5-mm).
e. Place tiles onto mortar bed, maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set.
f. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.

3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through routed joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

3.08 WALL TILE INSTALLATION

A. Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCNA installation methods related to types of construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

1. Latex Portland Cement Mortar Installation (using specified latex portland cement mortar material): ANSI A108.5.
2. Glass-mat, water-resistant, Gypsum Wallboard, Interior (Latex Portland Cement Mortar) Method: TCNA W245, place tiles maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown.
3. Cementitious Backerboard (Latex Portland Cement Mortar) Method: TCNA W244C, place tiles maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown.
4. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

3.09 CLEANING AND PROTECTING

A. Cleaning: On completion of placement, grouting and stripping, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer’s written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.

1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes the following:

1. Acoustical lay-in panel ceilings and exposed suspended metal grid ceiling system.
2. Perimeter trim and accessories.

B. Related Sections:

1. Interior Finish Schedule on the drawings
2. Division 23 – Air Diffusion Devices in Ceiling System.
3. Division 26 – Lighting Fixtures in Ceiling System.

1.02 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittals Procedures.

B. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

C. Shop Drawings: Layout and details of acoustical ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.

D. Reflected ceiling plans illustrating location of each access panels with identification of the type of access panel, as coordinated in the field with the Architect.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and address, names and addresses of Architects and Owner, and other information specified.

F. Certification: Manufacturers certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry and approved independent laboratory classification or NRC, CAAC and AC.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed acoustical ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling tile from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

D. Fire-Test Response Characteristics: Provide acoustical tile ceilings that comply with the following requirements:

1. Fire Resistance Rating: Test in accordance with ASTM E 119, UL Classified and listed in UL "Fire Resistance Directory."
2. Refer to Fire Resistance Directory for specified UL Design Number and related assembly construction data.
3. Surface-burning characteristics of acoustical tiles comply with ASTM E 1264 for Class A material as determined by testing identical products in accordance with ASTM E 84.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Areas receiving ceiling work shall be broom-clean and uninterrupted for free movement of rolling scaffold.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate layout and installation of acoustical tiles and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.07 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:

1. Acoustical Panels: Sagging and warping
2. Grid System: Rusting and manufacturer's defects

B. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.08 EXTRA STOCK MATERIALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering and identified with labels describing contents.

1. Acoustical Ceilings: Furnish quantity of all full-size units equal to 2 percent of acoustical units supplied for each type, composition, color, pattern, and size indicated.

B. Package each type of material separately, distinctly marked, and adequately protected against deterioration.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Refer to Interior Finish Schedule on drawings for Basis of Design manufacturer and product.

B. Subject to compliance with requirements, provide the products listed in the following Part 2 Articles or a comparable product by one of the following manufacturers:

1. Armstrong World Industries, Inc.
2. USG Interiors, Inc.
3. Certainteed

2.02 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING SYSTEM

A. Acoustical Panels: **2 x 4 Standard Acoustical Panels**

1. Type, Form, and Finish: Provide Type XII, Form 2, Pattern E I units in accordance with ASTM E1264 with factory applied latex painted white finish.

2. Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance: 0.90.
3. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton, 0.90
4. Articulation Class: 180
5. Edge Profile: Squarer Lay-in.
6. Panel Size: 24 inches by 48 inches by 3/4-inch thickness.
7. Mold/Mildew Inhibitor: The product shall be treated with a paint that contains a biocide that inhibits or retards the growth of mold or mildew, ASTM D 3273.
8. Flame Spread: ASTM E 1264; Fire Resistive Class A, Flame Spread less than 25.
9. Dimensional Stability: HumiGuard Plus

2.03 SUSPENSION SYSTEM

A. Components: Main beams and cross tees shall be commercial quality hot-dipped galvanized (galvanized steel, aluminum, or stainless steel) in accordance with ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping pre-finished galvanized steel in baked polyester paint.

1. Structural Classification: ASTM C 635, Heavy Duty.
2. Color: White Aluminum and match the actual color of the selected ceiling tile.
3. Grid Materials: Commercial quality steel with hot dipped galvanized coating.
4. Grid Finish: Factory applied baked polyester paint finish; Color: White.
5. Time-Rated Fire Resistance Assembly: UL Design Number as specified for Acoustical Ceiling Units.
6. All main runners and cross tees must bear appropriate UL Classification Markings.
7. Attachment Devices: Size for 5 times design load indicated in ASTM C635, Table 1, direct-hung.
8. Wire for Hangers and Ties: Zinc-coated carbon-steel wire, ASTM A641 Class 1 zinc coating, soft temper. Select wire diameter so its stress at three times hanger design load (ASTM C635, Table 1, direct-hung) will be less than yield stress of wire, but provide not less than 12 gauge-diameter wire.
9. Sheet Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
10. Support Channels and Hangers: Galvanized steel, size and type to suit application, to rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1/360.
11. Accessories: Hanger clips, splices, and hold down clips required for suspended grid system.
12. Type: Armstrong Prelude (15/16-inch) exposed tee grid system, minimum 0.020 metal thickness, or equal system of the other listed manufacturers.

2.04 MISCELLANEOUS MATERIALS

A. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission. Refer to Section 07 92 00 – Joint Sealants.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine substrates and structural framing to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affection performance of acoustical tile ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other Sections.

B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width units at borders, and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, in accordance with manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 24 inches from ends of each member.

C. Install edge molding and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical units.

1. Provide mitered corners with edge molding.
2. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
3. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8-inch in 12 feet. Miter corners accurately and connect securely.
4. Do not use expose fasteners, including pop rivets, on moldings and trim.
5. Paint cut edges of molding and trim after installation; match color of grid using coating recommended in writing for this purpose by suspension system manufacturer.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

1. Coordinate location of suspension system to facilitate access to cable trays located above the ceiling, while respecting the layout of lighting and other ceiling penetrations. Access to trays should occur directly adjacent to the tray. Ceiling panels directly below the tray will not be removed for access.
2. Align new suspension system with existing system that is to remain.

E. Coordinate the locations of upward ceiling access panels and downward ceiling access panels in the field with other disciplines and the Architect. Identify each access panel with a small black dot discreetly located and securely attached to the ceiling.

F. Arrange directionally-patterned acoustical tiles per reflected ceiling plans.

G. Install lay-in acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
2. Comply with UL Design Number for acceptable component and hanger wire spacing, number and size of acoustical panels, fixture protection and other installation requirements.

3. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions.
4. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.04 TOLERANCES

A. Variation from Flat and Level Surface: 1/8-inch in 12 feet.

B. Variation from Plumb of Grid Members Caused by Eccentric Loads: Two degrees maximum.

3.05 CLEANING

A. Clean exposed surfaces of acoustical tile ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 54 26

SUSPENDED WOOD CEILINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes grooved wood suspended ceiling panel system.

B. Related Sections:

1. Division 21 sections – Fire Suppression.
2. Section 26 56 02 – Architectural Lighting Interior.
3. Section 26 83 11 – Fire Detection and Alarm.

1.02 REFERENCES

A. ASTM C423: Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

B. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials

C. CISCA: Ceiling Systems Handbook

1.03 DESIGN / PERFORMANCE REQUIREMENTS

A. Suspension System: Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1:360.

B. Wood is a natural product that will undergo changes with variations in the environment. Therefore, all dimensional tolerances are plus or minus 1/8 inch (3 mm).

C. Seismic Suspended wood ceilings meet seismic code compliance via direct screw attachment to heavy duty grid. Local code requirements should be consulted in order to determine additional requirements.

D. Fire Performance Characteristics: Suspended wood ceilings shall conform to Class 1, or A flame spread rating, tested according to ASTM E 84; Flame Spread: 25 or less. Smoke Developed: 450 or less.

E. Certified Wood: Suspended wood ceilings shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification

1.04 ACTION SUBMITTALS

A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Provide layout of suspended wood ceiling and T-rails coordinated with other trades that will penetrate the wood ceiling or interfere with the installation and recessed or surface mounted devices located within the ceiling panels. Indicate method of suspension where interference exists.

D. Selection Samples: For each finish product specified, two complete sets of color brochures representing the manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 12 inches (305 mm) square, representing actual product, color, and patterns.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

G. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment and periodic cleaning and maintenance of all components.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Minimum 2 years documented experience installing projects of similar size and complexity.

C. Provide seismic design of suspended ceiling under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.
4. Accepted mock-ups shall be comparison standard for remaining Work

E. Pre-Installation Conference: Convene minimum two weeks prior to starting work of this section. Agenda shall include project conditions, coordination with work of other trades, and layout of items that penetrate ceilings.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in the manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store products off the floor in manufacturer's unopened packaging protected from exposure to harmful environmental conditions and at temperature and humidity conditions as recommended by the manufacturer.

C. A minimum of 72 hours prior to ceiling installation, suspended wood ceilings shall be stored in the room in which they will be installed. Temperature and humidity of the room during this period shall closely approximate those conditions that will exist when the building is occupied.

D. Handle materials to avoid damage.

1.07 SEQUENCING

A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Plenums have proper ventilation, especially in high moisture areas with no excessive buildup of heat in the ceiling areas.

C. Space shall be fully enclosed with all exterior windows and doors in place, glazed, and weather-stripped. Roof is to be watertight, and all wet trades' work is to be completed, and thoroughly dry.

D. Mechanical, electrical, and other utility services above the ceiling plane shall be completed. No materials should rest against, or wrap around, the ceiling suspension components or connecting hangers.

E. Install only when the temperature and humidity closely approximate the interior conditions that will exist when the building is occupied. Heating and cooling systems shall be operating before, during, and after installation, with the humidity of the interior spaces maintained between 25 and 55 percent, and a temperature between 60 to 90 degrees F.

1.09 COORDINATION

A. Coordinate layout and installation of the wood slats ceiling systems with other work penetrating the ceiling including light fixtures, HVAC equipment, and fire suppression system components.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer: MCM Acoustical, Mississauga, ON

2.02 CEILING PANELS

A. Product: GROOVED WOOD PANELS with nominal thickness of 16mm (5/8”)

B. Veneer Option: Quarter cut, Slip Match, Cut, etc.

C. Panel Construction: Natural wood veneer to be laminated on fire rated medium density fiberboard (MDF) and grooved. Back and core of the panel to be have 9mm perforations staggered based on face groove spacing. The MDF core material shall be furnished with special acoustical black matt at the back. Panel sizes as per approved shop drawings.

D. Suspension System: Panels can be suspended directly to substrate via provided z-clips or torsion spring may be used to attach panels to grid. All suspension hardware beyond the grid including the hanger wires, rods, braces, and moldings to be provided by others as per ASTM standards

2.03 ACCESSORLES

A. Cliprail: Attachment clips are spring-steel with phosphate pre-treatment and corrosion-resistant coating and are attached at pre-spaced intervals to heavy-duty grid.

B. C-Hangers: Suspension hangers that are direct-screwed to the panel and hang over the heavy duty-grid. Hangers are made of spring-steel with phosphate pre-treatment and corrosion-resistant coating.

C. Torsion Springs and Saddle Clips: Two parts of a suspension system in which the torsion spring is direct-screwed to the panel and compressed to attach to the saddle clip that is fitted over the heavy duty-grid. Springs and clips are made of spring-steel with phosphate pre-treatment and corrosion-resistant coating.

D. Z-Clips: Male/female aluminum attachment clips, similar to a French cleat but with a thinner profile, used to hang wood wall panels on furring strips.

E. Integrated Lighting System: Coordinate ceiling panels with lighting specified in Section 26 56 02 – Architectural Interior Lighting.

2.04 SUSPENSION SYSTEMS

A. Main Tees: Standard heavy duty 15/16 inch (24 mm) T-rail specified in Section 09 22 16 – Non-Structural Metal Framing.

B. Hangers; shall be Suspend ceiling panels from T-rail using torsion springs, C-hangers, or direct screw attachment, as recommended by the manufacturer.

1. System for Linear 4.5 inch open, 6 inch open, and 4 inch closed shall consist of Rulon cliprails, installed on #12-gauge wire hangers.
2. Linear wood system cliprail shall use clips factory-attached to the main tees, factory indexed to maintain the specified module.

2.05 FABRICATION

A. Edges, borders, and perimeter trims shall be indicated on the Drawings in accordance with the manufacturer's standard design details. All suspended wood ceiling products specified shall be supplied by the wood slat ceiling manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify that T-rail carriers specified in Section 09 22 26 - Suspension Systems are in place, suspended and leveled in a direction perpendicular to the wooden strip direction of the wood panels.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Work shall not begin until the space is fully enclosed and glazed and all wet work is completed and dried out to the satisfaction manufacturer.

C. Temperature shall be at least 65 degrees Fahrenheit during the installation and thereafter.

D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction, including the following:

1. Comply with ASTM C 636 and seismic design requirements indicated.
2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
3. Additional Hanger Wires: Wrapped tightly 3 full turns to structure and component at locations where imposed loads could cause deflection exceeding 1/360 span or tolerances specified below.

B. Use a laser leveling device to lay out and install the perimeter trim as specified.

C. Suspend wood slats from the cliprail system using integrated linear clips.

D. Make final adjustments to level or contours as required.

3.04 FIELD QUALITY CONTROL

A. Technical Service: Manufacturer shall provide a local Technical Service Representative for on-site training and assistance during the installation process.

B. Environmental Monitoring: Manufacturer shall provide a temperature and humidity sensor to actively monitor the room in which the wood slats shall be installed for a minimum of one week before and up to two weeks after installation has been completed including all of the weeks in between.

C. Upon completion of ceiling installation, the owner's representative shall inspect all finished surfaces to ensure that the work has been completed in a manner satisfactory to the owner. Any deficiencies in the install of the ceiling shall be corrected prior to substantial completion.

3.05 ADJUSTMENTS AND CLEANING

A. Clean exposed surfaces of ceiling panel in accordance with manufacturer's instructions.

B. Remove and replace panels and tiles, which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 09 54 29

SUSPENDED PLASTIC CEILINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes exterior suspended polymer ceiling at entrance canopy ceiling

1.02 REFERENCES

A. ASTM E 84 - Title; 2001.

B. FSC STD-01-001 - FSC Principles and Criteria for Forest Stewardship

C. FSC STD-40-004 - FSC Standard for Chain of Custody Certification

D. U.S. Green Building Council, LEED Building Design and Construction (BD+C)Version 4.0 Rating System. (LEED v4.0)

1.03 DESIGN / PERFORMANCE REQUIREMENTS

A. Suspension System: Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1:360.

B. Wood is a natural product that will undergo changes with variations in the environment. Therefore, all dimensional tolerances are plus or minus 1/8 inch (3 mm).

C. Seismic Suspended wood ceilings meet seismic code compliance via direct screw attachment to heavy duty grid. Local code requirements should be consulted in order to determine additional requirements.

D. Fire Performance Characteristics: Suspended wood ceilings shall conform to Class 1, or A flame spread rating, tested according to ASTM E 84; Flame Spread: 25 or less. Smoke Developed: 450 or less.

1.04 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Provide layout of suspended wood ceiling and T-rails coordinated with other trades that will penetrate the wood ceiling or interfere with the installation and recessed or surface mounted devices located within the ceiling panels. Indicate method of suspension where interference exists.

D. Selection Samples: For each finish product specified, two complete sets of color brochures representing the manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 12 inches (305 mm) square, representing actual product, color, and patterns.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

G. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment and periodic cleaning and maintenance of all components.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Minimum 2 years documented experience installing projects of similar size and complexity.

C. Provide seismic design of suspended ceiling under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.
4. Accepted mock-ups shall be comparison standard for remaining Work

E. Pre-Installation Conference: Convene minimum two weeks prior to starting work of this section. Agenda shall include project conditions, coordination with work of other trades, and layout of items that penetrate ceilings.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in the manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store products off the floor in manufacturer's unopened packaging protected from exposure to harmful environmental conditions and at temperature and humidity conditions as recommended by the manufacturer.

C. A minimum of 72 hours prior to ceiling installation, suspended wood ceilings shall be stored in the room in which they will be installed. Temperature and humidity of the room during this period shall closely approximate those conditions that will exist when the building is occupied.

D. Handle materials to avoid damage.

1.07 SEQUENCING

A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Plenums have proper ventilation, especially in high moisture areas with no excessive buildup of heat in the ceiling areas.

C. Space shall be fully enclosed with all exterior windows and doors in place, glazed, and weather-stripped. Roof is to be watertight, and all wet trades' work is to be completed, and thoroughly dry.

D. Mechanical, electrical, and other utility services above the ceiling plane shall be completed. No materials should rest against, or wrap around, the ceiling suspension components or connecting hangers.

E. Install only when the temperature and humidity closely approximate the interior conditions that will exist when the building is occupied. Heating and cooling systems shall be operating before, during, and after installation, with the humidity of the interior spaces maintained between 25 and 55 percent, and a temperature between 60 to 90 degrees F.

1.09 COORDINATION

A. Coordinate layout and installation of the wood slats ceiling systems with other work penetrating the ceiling including light fixtures, HVAC equipment, and fire suppression system components.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer: Rulon International, St Augustine, FL

1. Rulon Endure Linear 800

B. Acceptable Manufacturers:

1. Products of these manufacturers shall meet or exceed specification requirements for the “Basis of Design” product. Pattern and color will be selected by the Architect.

a. ASI Architectural
b. Armstrong
c. Certainteed

2.02 MATERIALS - GENERAL

A. Linear ceilings will undergo changes with variations in the environment. Therefore, all dimensional tolerances are plus or minus 1/8 inch (3 mm).

2.03 ENDURE CEILING PANELS

A. Endure suspended linear systems are fabricated with strips that are nearly inert to harsh, moist weather conditions. Strips are completely recyclable.

1. Rulon 800 Series Engineered Polymer Strips:

a. Ceiling pans are provided with spacers between the edges of each strip, with the flat face visible.
b. Ceiling pans are 3-1/4 inches (83 mm) wide, and placed into a design module of 4 inches (102 mm) with square sides.

2.04 LINEAR CEILING PANELS

A. Linear Open Style: Provided in random lengths with tongue and groove ends or in fixed lengths. Standard lengths are 3 feet to 10 feet.

1. Module Size:

a. 4-inch module, having wood strips 3/4 inch thick by 3-1/4 inch wide, and a 3/4 inch reveal.

2. Trim and Border Treatment: Provide end caps or junction trims as indicated.

2.05 ACCESSORLES

A. Cliprail: Attachment clips are spring-steel with phosphate pre-treatment and corrosion-resistant coating and are attached at pre-spaced intervals to heavy-duty grid.

B. C-Hangers: Suspension hangers that are direct-screwed to the panel and hang over the heavy duty-grid. Hangers are made of spring-steel with phosphate pre-treatment and corrosion-resistant coating.

C. Torsion Springs and Saddle Clips: Two parts of a suspension system in which the torsion spring is direct-screwed to the panel and compressed to attach to the saddle clip that is fitted over the heavy duty-grid. Springs and clips are made of spring-steel with phosphate pre-treatment and corrosion-resistant coating.

D. Z-Clips: Male/female aluminum attachment clips, similar to a French cleat but with a thinner profile, used to hang wood wall panels on furring strips.

E. Integrated Lighting System: Coordinate ceiling panels with lighting specified in Section 26 56 02 – Architectural Interior Lighting.

2.06 SUSPENSION SYSTEMS

A. Suspension Rail: Standard suspension carrier shall be of Rulon manufacture, and consist of commercial grade steel with surface prepared, and painted. In swimming pool and other corrosive environments, use the Rulon suspension carrier coated with black protective coating system.

2.07 FABRICATION

A. Edges, borders, and perimeter trims shall be indicated on the Drawings in accordance with the manufacturer's standard design details. All suspended wood ceiling products specified shall be supplied by the wood slat ceiling manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify that suspension rail specified in Section 09 22 16 – Non-Structural Metal Framing are in place, suspended and leveled in a direction perpendicular to the wooden strip direction of the wood panels.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Work shall not begin until the space is fully enclosed and glazed and all wet work is completed and dried out to the satisfaction manufacturer.

C. Temperature shall be at least 65 degrees Fahrenheit during the installation and thereafter.

D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction, including the following:

1. Comply with ASTM C 636 and seismic design requirements indicated.
2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
3. Additional Hanger Wires: Wrapped tightly 3 full turns to structure and component at locations where imposed loads could cause deflection exceeding 1/360 span or tolerances specified below.

B. Perimeters: Use a laser leveling device to lay out and install the perimeter trim as specified.

C. Suspension System: Suspension rail shall be placed perpendicular to the desired linear strip direction and positioned on 3' (915mm) or 2’ (610mm) centers - as specified by the manufacturer. Carriers shall be suspended from specified hangers - starting 6" (152mm) from one wall, then on specified centers, with the last carrier positioned within 6" (152mm) of the other wall. Specified hangers shall be attached directly to structure, or to inserts, screw eyes, or other devices that are secure, and that will not deteriorate or fail with age or elevated temperatures.

D. Linear Strips: Linear strips shall be fully attached to the carrier by snapping one side of the strip into position first, followed by the second side. When properly installed, the strips shall be firmly secured, and fully level. When spacers and acoustical blankets are specified, they shall be fitted as the installation of strips progresses. End cuts are butted tight together by snapping a connector behind the strips to create a secure, aligned joint.

E. Make final adjustments to level or contours as required.

3.04 FIELD QUALITY CONTROL

A. Technical Service: Manufacturer shall provide a local Technical Service Representative for on-site training and assistance during the installation process.

B. Environmental Monitoring: Manufacturer shall provide a temperature and humidity sensor to actively monitor the room in which the wood slats shall be installed for a minimum of one week before and up to two weeks after installation has been completed including all of the weeks in between.

C. Upon completion of ceiling installation, the owner's representative shall inspect all finished surfaces to ensure that the work has been completed in a manner satisfactory to the owner. Any deficiencies in the install of the ceiling shall be corrected prior to substantial completion.

3.05 ADJUSTMENTS AND CLEANING

A. Clean exposed surfaces of ceiling panel in accordance with manufacturer's instructions.

B. Remove and replace panels and tiles, which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 09 65 13

RESILIENT BASE

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes resilient base and flooring transition strips.

B. Related Sections/Drawings:

1. Schedule of Finishes on the drawings.
2. Section 09 68 13 – Tile Carpeting

1.02 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product specified, describing physical and performance requirements, sizes, patterns, and colors available.

1.03 INFORMATIONAL SUBMITTALS

A. Product Certificates: Signed by manufacturers of resilient wall base and accessories certifying that each product furnished complies with requirements.

B. Maintenance Data: Include in operating and maintenance manual specified in Section 01 77 00 – Closeout Procedures.

1.04 QUALITY ASSURANCE

A. Provide each type of resilient accessory as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.

B. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

C. Materials shall be from a single production run and indicated on the carton label bearing the manufacturers color code. The color shall be uniform throughout.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing name of product and manufacturer, Project identification, and shipping and handling instructions.

B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 degrees F (10 and 32 degrees C).

C. Move products into spaces where they will be installed at least 48 hours before installation, unless manufacturer recommends longer conditioning period in writing.

1.06 PROJECT CONDITIONS

A. Install base and accessories after other finishing operations, including painting, have been completed.

B. Maintain a temperature of not less than 70 degrees F or more than 95 degrees F in spaces to receive products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After postinstallation period, maintain a temperature of not less than 55 degrees F or more that 95 degrees F.

C. Do not install products until they are at the same temperature as the space where they are to be installed.

D. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Refer to plans for manufacturers and products.

B. Wall Base:

1. Basis of Design: Johnsonite
2. Acceptable Manufacturers:

a. Forbo
b. Roppe

C. Vinyl Edge Strips:

1. Basis of Design: Johnsonite
2. Acceptable Manufacturers:

a. Forbo
b. Roppe

D. Metal Transition Strips:

1. Basis of Design: Schluter Systems

2.02 THERMOSET RUBBER WALL BASE

A. Manufactured from a proprietary thermoplastic rubber formulation.

B. Product Criteria: Meets performance requirements for ASTM F 1861 Standard Specification for Resilient Wall Base, Type TP, Group 1 and the following.

1. ASTM E 648, Standard Test Method for Critical Radiant Flux of 0.45 watts/cm2 or greater, Class I.
2. ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials, Class A, Smoke <450.
3. Flexibility: Does not crack, break, or show any signs of fatigue when bent around a 1 1/4" diameter cylinder when tested according to ASTM F 137 Standard Test Method for Flexibility of Resilient Flooring Materials protocols.
4. Color Stability: Meets or exceeds ASTM F 1861 requirements for color stability when tested to ASTM F 1515 Standard Test Method for Measuring Light Stability of Resilient Flooring protocols.

C. Minimum Thickness: 0.125 inch

D. Height: 6 inch.

E. Coved at resilient tile and concrete, straight at carpet.

F. Base Accessories: Premolded end stops and external corners of same material, size and color as base.

2.03 VINYL EDGE STRIPS

A. Basis of Design: Selected profile and height required to protect exposed edge of carpet and vinyl tile, and of maximum lengths to minimize running joints.

B. Color: Colors to blend with flooring materials, as selected by the Architect from manufacturer’s full range.

2.04 METAL TRANSITION STRIPS

A. Basis of Design: Schluter Systems of Platsburgh, NY.

2.05 INSTALLATION ACCESSORIES

A. Primers and Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.

1. Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
2. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.

B. Do not proceed with installation until unsatisfactory conditions have been corrected. Beginning of installation means acceptance of existing substrate underlayment and site conditions.

3.02 PREPARATION

A. General: Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.

B. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do no proceed with installation until unsatisfactory conditions have been corrected.

3.03 RESILIENT ACCESSORY INSTALLATION

A. General: Install resilient accessories according to manufacturer's written installation instructions.

B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
3. Do not stretch base during installation.
4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
5. Preformed corners: Install preformed corners if available before installing straight pieces.
6. Job-formed corners: (Inside corners only)

    a. Inside corners: Form inside corners on job, from straight pieces of maximum lengths possible, by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

C. Place resilient accessories so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

3.04 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing resilient products:

1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
2. Sweep or vacuum floor thoroughly.

B. Protect accessories against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by product manufacturer.

END OF SECTION

SECTION 09 65 16

RESILIENT FLOORING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes types of resilient flooring. Furnish and install resilient flooring directly adhered over floors, where indicated on the Drawings, including all accessories necessary to complete the work.

B. Section includes the following types of resilient flooring:

1. Rubber flooring
2. Luxury Vinyl Tile (LVT)

C. Related Section:

1. Section 09 05 61 – Common Work Results for Floor Preparation
2. Basis of Design Colors/Finish: Refer to Schedule of Finishes on drawings

1.02 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product specified, describing physical and performance requirements, sizes, patterns, and colors available.

1.03 INFORMATIONAL SUBMITTALS

A. Maintenance Data: Include in operating and maintenance manual specified in Section 01 77 19 – Closeout Requirements.

1.04 QUALITY ASSURANCE

A. Provide each type of resilient flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.

B. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspection agency acceptable to authorities having jurisdiction.
1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested in accordance with ASTM E 648.
2. Smoke Density: Maximum specific optical density of 450 or less when tested in accordance with ASTM E 662.

D. Materials shall be from a single production run and indicated on the carton label bearing the manufacturers color code. The color shall be uniform throughout.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing name of product and manufacturer, Project identification, and shipping and handling instructions.

B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 degrees F (10 and 32 degrees C).

C. Store tiles on flat surfaces.

D. Move products into spaces where they will be installed at least 48 hours before installation, unless manufacturer recommends longer conditioning period in writing.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit cleaning and maintenance information including maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping and re-waxing.

1.07 PROJECT CONDITIONS

A. Install tiles and accessories after other finishing operations, including painting, have been completed.

B. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.

C. Maintain a temperature of not less than 70 degrees F (21 degrees C) or more than 95 degrees F (35 degrees C) in spaces to receive products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post-installation period, maintain a temperature of not less than 55 degrees F (13 degrees C) or more that 95 degrees F (35 degrees C).

D. Do not install products until they are at the same temperature as the space where they are to be installed.

E. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, basis of design manufacturers and products of the manufacturer are indicated in the Schedule of Finishes on the drawings.

2.02 MATERIALS

A. Resilient flooring basis of design selections: As indicated in the Schedule of Finishes.

B. Acceptable Products: LVT:

1. Products of these manufacturers shall meet or exceed specification requirements for the "Basis of Design" product. Pattern and color will be selected by the Architect.

    a. Interface

C. Acceptable Products: Rubber Sheet Flooring

1. Products of these manufacturers shall meet or exceed specification requirements for the "Basis of Design" product. Pattern and color will be selected by the Architect.

    a. Interface

2.03 LVT (PLANK)

A. Products: Subject to compliance with requirements, provide products indicated in Finish Schedule on Drawings.

B. Tile Standard: ASTM F 1700.

1. Class: Class III, printed film vinyl tile.
2. Type: A, smooth surface and B, embossed surface.

C. Thickness: 4.5 mm.

D. Size: 25cm x 1m.

E. Color: As indicated in the Finish Schedule on Drawings.

2.04 RESILIENT SHEET

A. Construction - Homogeneous Sheet,- ASTM F1913

B. Overall Thickness - 0.080 in. (2.0 mm)

C. Wear Layer Thickness - 0.080 in. (2.0 mm)

D. Size - Up to 98.4 ft (30 m) 6 ft. 7 in. (2.0 m)

E. Factory Finish - Diamond 10® Technology with Enhanced Traction

F. Installation - Full Spread Adhesive: S-995, Flash Cove Adhesive: S-580,

G. Seams: Heat Weld or S-761 Seam Adhesive

H. Color: As indicated in the Finish Schedule on Drawings.

2.05 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient flooring and substrate conditions indicated.

1. Vinyl Floor Tile: Adhesives shall have a VOC content of 50 g/L or less.

C. Metal Edges Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

D. Sealer and Wax: Types recommended by flooring manufacturers.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient flooring products indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Prepare flooring substrates according to resilient flooring product manufacturer's written instructions to ensure adhesion of resilient flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient flooring product manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient flooring manufacturer's written recommendations, but not less stringent than the following:

    a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.03 RESILIENT FLOORING INSTALLATION – GENERAL

A. Comply with manufacturer's written instructions for installing resilient flooring.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings. Extend flooring to center of door openings.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.

E. Install flooring on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring to substrates that abut covers and to cover perimeters.

F. Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.04 RESILIENT FLOOR TILE INSTALLATION

A. General: Comply with tile manufacturer's written installation instructions.

B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter

1. Lay tiles square with room axis, unless otherwise indicated.

C. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped or deformed tiles.

1. Lay tiles with grain running in one direction.
2. Lay tiles in pattern of colors and sizes indicated on Drawings.

D. Scribe, cut and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosing.

E. Extend tiles into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, nonstaining marking device.

G. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.

H. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Hand roll tiles according to tile manufacturer's written instructions.

3.05 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing resilient products:

1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
2. Sweep or vacuum floor thoroughly.
3. Do not wash floor until after time period recommended by flooring manufacturer.
4. Damp-mop floor to remove marks and soil.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.

1. Apply protective floor polish to floor surfaces that are free from soil, visible adhesive, and surface blemishes, if recommended in writing by manufacturer.

    a. Use commercially available product acceptable to flooring manufacturer.
    b. Coordinate selection of floor polish with Owner's maintenance service.

2. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Contract Completion.
3. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
4. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Contract Completion in each area of Project. Clean products according to manufacturer's written recommendations.

    a. Before cleaning, strip protective floor polish that was applied after completing installation only if required to restore polish finish and if recommended by flooring manufacturer.
    b. After cleaning, reapply polish to floor surfaces to restore protective floor finish according to flooring manufacturer's written recommendations. Coordinate with Owner's maintenance program.

END OF SECTION

SECTION 09 68 13

TILE CARPETING

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes carpet tile for quick-release glue applications as scheduled and the following:

1. Edge strips, adhesives, and accessories to complete the work.
2. Preparation of floor surfaces to receive carpet tile.

B. Furnish and install carpet tile directly adhered over floors, where indicated on the Drawings, including all accessories necessary to complete the work.

C. Related Sections:

1. Finishes/Colors: Refer to Schedule of Finishes on drawings.
2. Section 09 05 61 – Common Work Results for Floor Preparation

1.02 REFERENCES

A. The Carpet and Rug Institute: Standard for Installation of Commercial Carpet (CRI 104 – Sept 2015)

1.03 ACTION SUBMITTALS

A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop drawings: 1/8 inch scale plans of all carpeted areas indicating direction of carpet, location of seams and method of joining seams.

1. Show location of different patterns or styles of carpet.

C. Show location of different fiber types, if mixed fiber types are used on the project, Selection samples:

1. Sample swatches containing manufacturer's full color and blend range.
2. Vinyl edge strip sample illustrating manufacturer's full color range.

D. Verification samples:

1. 12 inch long samples of edge strip.
2. After initial selection of carpet and color blends has been made by the Architect: 18 inches by 27 inches sample of selected carpet for final approval of the Architect. Approved samples shall be used as the standard of quality and colors for materials furnished under this Contract.

1.04 INFORMATIONAL SUBMITTALS

A. Information and Review Submittals:

1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties, for each item furnished hereunder, including carpet, accessories, adhesives, and leveling materials.
2. Manufacturer's installation instructions: Provide manufacturer's application methods or installation instructions for each item furnished hereunder. Indicate special procedures, and perimeter conditions requiring special attention.
3. Manufacturer's sample warranties.
4. Manufacturer's certificate: Provide certificate stating that the carpet, and other related materials to be supplied hereunder meet all requirements specified herein.

    a. Submit certification from the fiber producer verifying use of the branded fiber in the submitted carpet product.
    b. Certification should include the % recycled content by weight for fibers, describing the source of this recycled content. If virgin nylon is used, the manufacturer shall include, as part of the fiber certification, the precise method that will be used to recapture the nylon at the end of the useful life of the carpet. State whether it will be returned to nylon carpet, yarn

production, downcycled to an end use other than carpet yarn used for waste-to-energy conversion, or disposed of in a specified manner.

5. Indoor Air Quality Test Reports: Submit for specified products, indicating that the test results do not exceed the stated emission criteria of the CRI Indoor Air Quality Testing Program.

    1) the fiber type must be clearly identified to facilitate future recycling.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Qualification Data: Submit written certification in accordance with requirement in Quality Assurance from carpet manufacturer and supplier, certifying the following:

1. Carpet installer is a certified installer of carpet manufacturer's specified materials.
2. Carpet materials and construction provided under this Section meets or exceeds requirements specified, including static control, flammability properties, and IAQ - odor emissions and pre-conditioning requirements.
3. Provide written letter of acceptance from the carpet manufacturer or his representative stating that the moisture and pH tests results are within acceptable limits to warrant installation of flooring materials.

C. Chemical Emission/Indoor Air Quality: All carpet specified must be in compliance with the Carpet and Rug Institute (CRI) Indoor Air Carpet Testing Program. The program label and registration number serve as evidence of compliance. "Green Tag".

D. Fire test performance: Provide materials complying with referenced standard fire tests.

1. ASTM E84 (Tunnel Test): Flame spread less than 75 (Class B).
2. ASTM E662: Specific optical density, less than 450.
3. ASTM E684 (Radiant Panel): Critical Radiant Flux, Class 1, greater than 0.45 Watts/sq. cm.

E. Materials shall be from a single production run and colors shall be uniform throughout.

F. Sample Room (Mockup): Before commencing general installation, install carpeting in area designated by Architect for the purpose of establishing appearance and workmanship standards. Approved work will become the standard of comparison for all remaining work. Do not begin general installation until sample area has been approved by the Architect.

G. Flame/Smoke Resistance Standards: Provide carpet which has been tested and passes the following test standards:

1. Flammability: Comply with one of following:

    a. Pill Test: Test for flammability; ASTM D 2859, or DOC FF-1-70.
    b. Floor Radiant Panel Test: Test for burning under varying radiant energy levels; ASTM E 648, with minimum average radiant flux ratings not less than 0.45 watts/square centimeter (NFPA 253, Class 1).

2. Smoke Density Test: Test in radiant heat chamber, with and without flame, for density of smoke generated; ASTM E 662, or NFPA No. 258, also known as NBS Smoke Density Chamber Test, less than 450. Materials shall be from a single production run and colors shall be uniform throughout.

H. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Coordination." Review methods and procedures related to carpet installation including, but not limited to, the following:

1. Review delivery, storage, and handling procedures.
2. Review ambient conditions and ventilation procedures.

1.06 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with CRI 104, Section 5, "Storage and Handling."

B. Deliver carpeting to the job site in original mill wrappings with each roll having its register number properly attached.

C. Store carpeting and all accessories in an enclosed and dry area protected from damage and soiling.

D. Coordinate delivery schedule and storage space locations with the General Contractor.

E. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.07 PROJECT CONDITIONS

A. General: Comply with CRI 104, Section 7.0, “Site Conditions; Ambient Temperature and Humidity Suitable Substrates.”

B. Environmental Conditions: Maintain temperatures in space in accordance with carpet or adhesive manufacturer's recommendations, but in no case less than 65 degrees or above 95 degrees F. with a maximum relative humidity of 65%. If ambient temperatures are outside these parameter, Contractor shall not begin until HVAC system is operations and temperature and humidity parameters are maintained at least 48 hours before, during and for 72 hours after completion of work.

C. Substrate Conditions:

1. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

1.08 SEQUENCING AND SCHEDULING

A. Install carpet tile after other finishing operations, including painting have been completed to ensure that installed carpeting materials are not damaged, soiled or stained.

B. Do not install carpet tile until concrete slabs are sufficiently dry to bond with adhesive. Perform bond and moisture tests in accordance with Section 09 05 1, or other third party testing procedure recommended by carpet manufacturer to verify that concrete surfaces are dry and ready to receive carpet, and that adhesive is totally compatible with the substrate.

1.09 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Carpet Tile Warranty: Written warranty, signed by carpet tile manufacturer agreeing to replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

1. Warranty Period: 10 years from date of Contract Completion.

1.10 EXTRA MATERIALS

A. Furnish extra material described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Package extra materials in manufacturer's original unopened cartons and clearly label. Furnish 3% extra carpet tiles of each pattern and color installed. Provide overage expectations for each carpet type to contractor and facility beyond the extra tile quantities noted.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Specified Manufacturer: To establish a standard of quality, design and function desired, Drawings and specifications have been based on Mannington Carpets Inc., Calhoun, GA.

2.02 MATERIALS

A. Tile Carpeting *(CP1 as Building Standard)*

1. Product Construction: Tutted Pattern Loop
2. Yarn System: 100 percent Nylon
3. Dye Method: 100% Solution Dyed
4. Tufted Yarn Weight: 27 oz/yd²
5. Machine Gauge: 1/10 in
6. Pile Thickness: 0.19 in
7. Stitches: 13.00/in
8. Pile Density: 7,776
9. Size: 25 cm x 1m

B. General requirements: Carpet tiles, shall conform with or pass tests of the following Standards:

1. DOC-FF1-70 (Methenamine Reagent Pill Test).
2. ASTM E-648 (Flooring Radiant Panel Test): ≥ 0.45 watts/cm^2
3. NBS Smoke Chamber Test (ASTM E662): Less than 450.
4. AATCC-134 (Electrostatic Propensity): Less than 3.0 KV

2.03 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the following:

1. Carpet manufacturer: For full coverage, quick-release glue installation.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and that is recommended by the carpet manufacturer.

C. Edge Strips: Industry standards color as selected by the Architect.

D. Vinyl Edge Strips: Industry standard colors, as selected by the Architect, of width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Verify that substrates and conditions are satisfactory for carpet tile installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab Substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive boned. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Section 03 30 00 – Cast-in-Place Concrete for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. General: Comply with CRI 104, Section 8.0, "Substrate Preparation," and with carpet manufacturer's and installation system manufacturer’s written installation instructions for preparing substrates.

B. New Concrete: Remove all dirt, oil, grease, and other contaminants affecting bond. Vacuum surfaces thoroughly using industrial power vacuum immediately before installation. If necessary, damp mop floors with warm water. After cleaning, inspect substrate for visual evidence of moisture, alkaline salts, or dust.

1. Verify that slab substrates are free of materials which would interfere with bonding of adhesive.

2. Vacuum surfaces thoroughly using industrial power vacuum immediately before installation.
3. Fill minor holes, cracks, and transition areas with an approved latex-type underlayment. Trowel-on to smooth surface and allow to fully dry before applying carpet tile. Consult underlayment manufacturer's directions for drying times and other special requirements.
4. Comply with any additional instructions and recommendations of carpet and adhesive manufacturers for proper floor preparation.
5. Seal powdery or porous surfaces with sealer recommended by carpet manufacturer. If required, apply according to manufacturer's directions.

C. Moisture Tests: Determine moisture content and Ph levels of surfaces by performing appropriate tests. Do not apply materials over surfaces where moisture content exceeds that permitted by the resilient tile flooring manufacturer.

1. Subject to flooring manufacturer's approval, and type of under slab vapor barrier on grade, perform respective testing indicated in Section 09 05 61.
2. If moisture and Ph levels are acceptable with resilient flooring manufacturer, proceed with installation of materials. If test results exceed limitation, do not proceed with flooring installation until corrective action has been completed.

D. Use trowelable leveling and patching compounds, according to manufacturer’s written instructions, to fill cracks, holes and depressions in substrates.

E. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

F. Broom and vacuum clean substrates to be covered immediately before installing carpet tile. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

G. Prohibit traffic until filler is cured.

3.03 INSTALLATION – GENERAL

A. General: Comply with Carpet and Rug Institute “Standard for Installation of Commercial Textile Floor Covering Materials (CRI 104, Section 10 ‘Carpet Tile Installation”, and manufacturer's instructions and recommendations for installation of carpet by the full spread of pressure sensitive adhesive glue down method, except where more stringent requirements are shown or specified.

1. Patterns: Carpet tile shall be installed in patterns as indicated in locations shown in Finish Schedule and on drawings. Cut carpet evenly and accurately to fit neatly at walls, columns, and projections.
2. Installed carpet shall be free from ripples, ravels, frays, puckers and raw exposed edges. All loop pile tile will demonstrate some fuzzy edges due to normal manufacturing conditions. It is the contractor’s responsibility to trim all edges of tile to eliminate fuzzing at tile edges.
3. Extend carpet under open-bottomed obstructions and under removable flanges and furnishings, and into alcoves and closets of rooms indicated to be carpeted unless another floor finish is indicated for such spaces.
4. Provide cut-outs as indicated for removable access devices in substrate. Secure both sides of cuts to the substrate.
5. Install carpet edge guards where edge of carpet is exposed; anchor guards to substrate.
6. Do not bridge building expansion joints continuously with carpet tile, provide for movement.

3.04 INSTALLATION ON CONCRETE SLAB

A. General: Measure the area to find the best starting point to utilize full width perimeter tiles.

B. Pattern and starting point confirmation; prior to commencing installation all start points and tile pattern directions shall be confirmed with Architect/Designer. Refer to drawings for general tile zones, confirm all locations prior to installation.

C. Joints: Install carpet tiles with snug seams. Continually check that modules and patterns are being placed together with correct and uniform firmness.

1. Seam at doors, running parallel to doors, shall be centered directly under the closed door. Seams perpendicular to doors or entries are not acceptable.
2. Check correct snugness by measuring the distance covered by 11 installed modules (10 joints). This distance should be in compliance with manufacturer's specifications for the particular product being installed.
3. Care shall be taken not to trap yarn between modules.

D. Applying Adhesive: Apply carpet manufacturer's approved adhesive over the entire surface using a paint roller. Begin at center or starting point and work outward to the perimeter until the entire surface is covered with adhesive. Begin installing carpet tiles only after adhesive has turned from opaque to clear. To check, it will not transfer when touched with a finger. Do not install carpet tile into wet adhesive.

1. The chalk lines must be used as a guide for lining up the edges of modules. Using the pyramiding technique, install one quadrant at a time.
2. The corners of the modules should be flat to assure proper fit. Modules should be installed snug, but not jammed. Be careful to not over-tighten the installation.

E. Use the seam roller to blend and enhance the seams.

F. Trimming: The loop pile modules will have some yarn blossoming at the edges, which is inherent to this type of construction. Installer is responsible to trim all modules exhibiting this condition.

G. Vinyl Transition Strips: Install where carpet tile terminates exposing the edge of the material and where carpet tile terminates in doorway. Center reducers under doors. Bond reducers to substrate in straight, true lines.

3.05 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with CRI 104, Section 13, "Materials for Protection."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Protection shall be accomplished by using specified building paper. Edges shall be lapped 6 inches and secured with non-asphaltic tape. Covering shall be kept in repair and damaged portions replaced during the construction and move-in period.

END OF SECTION

SECTION 09 72 00

DIGITALLY PRINTED VINYL WALLCOVERING MURALS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide digitally printed wallcovering vinyl wallcovering, complete.

B. Related Sections:

1. Section 16 50 00 – Lighting: Permanent during installation.
2. Section 09 29 00 – Gypsum Board: Wall Substrates.
3. Section 09 91 00 – Painting: Preparation and priming of substrate surfaces.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. E 84 Test Method for Surface Burning Characteristics of Building Materials.

B. Wallcovering Association (WA):

1. WA-101-2011 Quality Standard for Polymer Coated Fabric Wallcovering.

C. Federal Specifications (FedSpec):

1. CCC-W- 408A Wallcovering, Vinyl Coated

D. Underwriters Laboratory, Inc. (UL)

1. UL 723: Test for Surface Burning Characteristics of Building Materials

E. National Fire Protection Agency (NFPA)

1. NFPA 101 Life Safety Code
2. NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth
3. CAN/ULC-S102 Test for Surface Burning Characteristics of Building Materials and Assemblies

1.03 ACTION SUBMITTALS

A. Submit one Color Proof for approval prior to manufacture of a full size miniature mural.

B. Submit one full size miniature strike-off for approval prior to the manufacture of full size mural

C. Submit manufacturers' product data and installation instructions for each digitally printed wallcovering mural, adhesive and accessory required.

1. Include data on physical properties, fire hazard classification and fire detection characteristics of wallcovering.
2. Include manufacturer's recommendations for maximum permissible moisture content of substrates.

D. Submit full-size samples, 54 inches wide by 36 inches long, cut from current production of each ground wallcovering selected to demonstrate quality, weight, color and embossing.

E. Submit manufacturer's written product certification that all furnished wallcovering ground meets or exceeds the specification requirements. Include certified copies of tests specified.

F. Submit wallcovering ground manufacturer's written instructions for recommended maintenance of each type of wallcovering required.

1.04 QUALITY ASSURANCE

A. Manufacturer: Provide each type of digitally printed vinyl wallcovering mural required produced by one manufacturer whose published product literature clearly indicates compliance of wallcovering ground with specified requirements.

B. Applicator: Installation by skilled commercial wallcovering applicators with no less than three years of documented experience installing wallcovering murals of the types and extent specified for the project.

C. Material Standards: Provide materials that meet or exceed Federal Specification CCC-W-408A and WA101 Quality Standard for Polymer Coated Fabric Wallcovering for Type I and Type II wallcovering.

D. Physical Properties: Provide wallcovering with the following physical properties when tested in accordance with ASTM D751.

1. Total weight: 21 oz./lin. yd
2. Tensile Strength: 50 X 55 Minimum (W x F)
3. Tear Strength: 25 X 25 Minimum (W x F)

E. Fire Hazard Classification: Provide materials that comply with Class A fire rating when tested in accordance with ASTM E84.

F. Underwriters Laboratories approval: Provide materials that have been tested and approved by Underwriters Laboratories.

G. Smoke Toxicity: Provide materials that have been tested for smoke toxicity and approved for use by New York City Materials and Equipment Acceptance Division (MEA).

H. Fire Detection Characteristics: Provide materials that have been laboratory tested for the Early Warning Effect® in accordance with ASTM E 603. Submit test results certifying that when one square foot section of the material is heated to 300 degrees F, the wallcovering emits an odorless, colorless non-toxic vapor that will activate an ionization smoke detector.

I. Low Emissions: Provide materials that meet the requirements of California Integrated Waste Management Board’s Special Environmental Requirements Specification CA 01350 for low emitting materials.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver digitally printed vinyl wallcovering mural to the project site in unbroken and undamaged wrappings and clearly labeled with the manufacturer's identification label, quality or grade, UL label and sidemark.

B. Store materials in a clean, dry storage area with temperature maintained above 55 degrees with normal humidity.

C. Store material in a flat position to prevent damage to roll-ends. Do not cross stack material. Support material off the floor in a manner to prevent sagging and warping.

1.06 PROJECT CONDITIONS

A. Do not apply digitally printed wallcovering mural when surface and ambient temperatures are outside the temperature ranges required by the wallcovering manufacturer.

B. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 60 degrees F unless required otherwise by manufacturer's instructions.

C. Apply adhesive only when substrate surface temperature or ambient temperature is above 60 degrees F, or relative humidity is below 40 percent.

D. Maintain constant recommended temperature and humidity for at least 72 hours prior to, throughout the installation period and for 72 hours after wallcovering installation completion.

E. Provide not less than an 80 foot candles per square foot lighting level minimum measured mid height at substrate surfaces.

1.07 WARRANTY

A. Submit manufacturer’s 5 year written warranty against manufacturing defects

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Digitally Printed Wallcovering Mural: 3M.

2.02 MATERIALS

A. Wallcovering: Pattern: _____. Type II conforming to Federal Specification CCC-W-408A and WA-101-A using test methods given in Federal Specification CCC-T-191 b excepted as otherwise specified.

1. Total Weight: ounces per linear yard.
2. Backing Weight: ounces per linear yard.
3. Vinyl Weight: ounces per linear yard
4. Thickness: inches
5. Fabric backing and content:

B. Digital Image: Owner/Architect to provide PDF file of on Type II Wallcovering.

2.03 ACCESSORIES

A. Adhesives: Premixed vinyl adhesive.

B. Substrate Primer/Sealer: White pigmented alkyd or acrylic/latex base primer specifically formulated for use with vinyl wallcoverings.

C. [Optional] Metal Moldings: Extruded aluminum, alloy 6063-T5, long lengths, with fine satin mechanical finish and class 2 clear architectural anodic coating conforming to AA M21A31 designed for use with vinyl wallcoverings.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and installation conditions.

B. Test substrates with a suitable moisture meter and verify that moisture content does not exceed 4 percent.

C. Verify substrate surfaces are clean, dry, smooth, structurally sound and free from surface defects and imperfections that would show through the finished surface.

D. Evaluate all painted surfaces for the possibility of pigment bleed-through.

E. Notify the contractor and architect in writing of any conditions detrimental to the proper and timely completion of the installation. Beginning of installation means acceptance of surface conditions.

3.02 INSTALLATION

A. Allow digitally printed vinyl wallcovering mural to acclimatize to the area of installation a minimum of 24 hours before installation.

B. Before cutting, examine image and color and determine that they are the correct image and color as specified for the correct location.

C. Read and follow the instructions in the manufacturer's installation sheet contained in each roll of the digitally printed vinyl wallcovering mural.

D. Use adhesive recommended by the wallcovering manufacturer.

E. Install each panel in sequence as indicated on the drawings.

F. If there are variations in color or image that are considered to be excessive, notify the manufacturer's representative for an inspection before any further wallcovering is installed.

G. Smooth wallcovering to the hanging surface using a stiff bristled sweep brush to eliminate air bubbles, wrinkles, gaps and overlaps.

H. Remove excess adhesive along finished seams immediately after each wallcovering strip applied. Use clean warm water, a natural sponge and clean towels. Change water often to maintain water cleanliness.

3.03 CLEAN-UP COMPLETION

A. Upon completion of the work, remove surplus materials, rubbish and debris resulting from the wallcovering installation. Leave areas in neat clean and orderly condition.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes surface preparation and field painting and finishing of interior and exterior surfaces including:

1. Scheduled and otherwise identified surfaces.
2. Exposed surfaces including exposed interior piping, ducts, and conduit.
3. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified in other sections, and include sealers, primers, stains, fillers and other applied materials used as prime or intermediate coats.

B. Related Sections/Drawings:

1. Schedule of Finishes and Legend on drawings.

C. Interior items and surfaces not requiring painting, unless noted otherwise:

1. Where specifically omitted.
2. Items and surfaces permanently concealed in inaccessible areas such as above ceilings; including pipe, pipe covering, hangers, and conduit.
3. Prefinished or naturally finished items such as exposed ornamental metalwork, sheet metal work, bronze, stainless steel, aluminum, and other prefinished materials.
4. Labels, including code-required labels, equipment name, identification, performance rating or nomenclature plates.
5. Operating parts.
6. Surfaces where finishing is specified under other sections of the specifications.
7. Items with factory applied finishes.
8. Brick, stone, ceramic tile, plastic laminate.
9. Moving parts of operating units.
10. Acoustical ceilings.

D. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically describe a particular item or a surface for a coating or color, paint the item or surface the same as similar adjacent equipment, materials or surfaces. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

1.02 DEFINITIONS

A. "Paint" as used herein means coating system materials including primers, emulsions, epoxy, enamels, sealers, fillers, and other applied materials whether used as prime, intermediate, or finish coats.

B. Conform to PDCA Glossary for interpretation of terms used in this Section except as modified below.

1. EXPOSED SURFACES: Surfaces of products, assemblies, and components visible from any angle after final installation. Includes internal surfaces visible when operable doors, panels or drawers are open, and surfaces visible behind registers, grilles, or louvers.
2. CONCEALED SURFACES: Surfaces permanently hidden from view in finished construction and which are only visible after removal or disassembly of part or all of product or assembly.
3. INACCESSIBLE SPACES: Spaces not intended for human use.
4. Spaces listed below are defined as CONCEALED or INACCESSIBLE:

   a. Space between suspended ceilings and floor or roof construction above.
   b. Inside furred spaces.
   c. Inside of partitions

d. Mechanical and electrical items enclosed within casework or equipment.
e. Foundation spaces.
f. Crawl spaces.
g. Trenches and manholes.
h. Mechanical shafts or chases.
i. Enclosed elevator shafts (unless otherwise noted)
j. Utility tunnels.

1.03 COLOR SCHEDULE

A. Schedule:

1. Obtain schedule in advance of commencing work.
2. Omissions in the color schedule shall not relieve the Contractor from performance in accordance with requirements of the Contract Documents.
3. Obtain Architects color, texture and sheen approval for painting unscheduled surfaces, if any.

1.04 ACTION SUBMITTALS

A. Prepare submittals in accordance with Section 01 33 00 –- Submittal Procedures.

B. Product Data:

1. Submit complete schedule of products proposed for use, by brand name and/or number including manufacturer's label analysis and description of products and their suitability for intended use for approval.

   a. Identify each material by manufacturer’s catalog number, product name, and generic classification.
   b. Include typewritten list identifying paint systems and colors applied to each room, space, or item.

2. Specifically include percent solids by volume, VOC content (pound/gallon).

C. Samples for Color and Sheen: Prepare one sample of each opaque finish paint specified in each color and sheen scheduled for appearance verification.

1. Apply to 12 inch by 12 inch by ¼ inch hardboard. Apply sufficient paint thickness to provide proper hiding and appearance.
2. Label each sample to indicate material, color, by color formulation designation, and sheen.
3. On one-half of the sample show the completed treatment, and on the other half show the successive steps taken in producing the finish.

   a. Step back each coat and process at least on inch to show bare substrate and each coat and process in system build-up.
   b. Label each sample to indicate materials, color sheen, DFT or each coat applied, and total system DFT.

4. Approved samples will be so marked; one set will be returned for the painter's use.
5. Approved samples shall be standard of finish and color to be selected.
6. No finishes shall be applied on the work until samples are approved.

D. Informational Submittals: Submit the following separate for other submittals:

1. Certification specified in Quality Assurance article.
2. Manufacturer’s instructions.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Single Source Responsibility: Provide products of a single manufacturer for use in each paint system. Do not mix product of different manufacturers without approval of Architect and manufacturers involved.

1.06 PRECONSTRUCTION CONFERENCE

A. Conduct pre-installation conference in accordance with Section 01 31 00 – Project Coordination.

B. Conference attendance by Owner, Architect, Contractor, Installer, and manufacturer's representative authorized to certify Installer as an approved applicator.

C. Tentative agenda:

1. Discuss sequence and scheduling, installation procedures and interface with other trades.
2. Review requirements and conditions which could possibly interfere with successful performance of work.
3. Preview project specification and drawings.
4. Review basis and coordination to determine acceptability of surfaces to receive paints and coatings.
5. Review environmental and ventilation requirements.
6. Where required by warranty requirements, include scheduling requirements for manufacturer representative to confirm acceptability of surfaces. Include surface preparation to receive paints and coating, acceptable application methods and techniques for painting and coating, and acceptable completion of work to permit issuance of warranty.

1.07 FIELD SAMPLES

A. Field Quality Control: Provide benchmark samples of paint coatings under provisions of Section 01 40 00 – Quality Control Requirements.

B. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Duplicate finish of approved drawdown and Verification Sample submittals.

1. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted. Finish the area in accordance with specification requirements for applicable substrate surfaces and items.
    a. Ceiling and Wall Surfaces: Provide field sample panel of minimum 100 square feet in size for wall and ceiling surfaces
    b. Small Areas and Items: The Architect will designate an item or area as required.
2. Apply Benchmark Samples, according to requirements for the completed Work. Provide required sheen, color, texture, color intensity, and technique on each surface.
    a. A color will be selected from the color palette to be used in the project.
    b. After finishes are accepted, Architect will use the surface to evaluate coating systems of a similar nature.
3. After temporary lighting and other environmental services have been activated, apply coatings to each surface according to the Paint and Coatings Schedules at the end of this section. Provide required sheen, color, and texture on each surface.
    a. After finishes of mockups are accepted by the Architect, the Architect will use the approved mockup as the project standard for painting and coating work.
4. Execute all work under favorable conditions suitable for the production of good, durable work.
5. Acceptance will be based on a final inspection of work by the Architect made at one time.
6. Final approval of colors will be from job-applied samples.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 60 00 – Product Requirements.

B. Deliver materials in sealed containers, premixed and packaged by the manufacturer (or his authorized distributor), bearing the manufacturer's standard label showing trade name and number, label analysis, and directions for use.

1. Label containers to indicate manufacturer's name, Product name and type of paint, brand code or stock number, date of manufacturer, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.

2. Do not open containers until contents are to be used.

C. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F and maximum 90 degrees F. Maintain containers used in storage in a clean condition, free of foreign materials and residue, and with labels maintained in legible condition.

D. Upon completion of work, leave storage area clean and in same condition as remainder of work.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Environmental Conditions: Comply with the more restrictive of the following or manufacturer's requirements under which systems can be applied.

1. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures within specified limits and to exhaust hazardous fumes.
2. Maintain temperature and humidity conditions for minimum 24 hours before, during, and 48 hours after application of finishes, unless longer times are required by manufacturer.
3. Do not permit wide variations in ambient temperatures which might result in condensation on freshly coated surfaces.
4. Apply water-based paints only when surface temperature and surrounding air temperatures in each room are between 50 degrees F and 95 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.
5. Apply solvent-thinned paints only when surface temperature and surrounding air temperatures in each room are between 45 degrees F and 95 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.

B. Do not apply interior coatings under any of the following conditions:

1. When surface is not within the allowable moisture content as permitted by the paint manufacturer.
2. When relative humidity is less than 20 percent or exceeds 85 percent.
3. When temperature is less than 5 degrees F above dew point.
4. When dust may be generated before paints have dried.

C. Provide lighting level of 80 foot candles measured mid-height at substrate surface during application of paints.

1.10 COORDINATION

A. Review other section specifying prime coats to ensure compatibility of the total paint system for various substrates.

1. Upon request from other trades, furnish information on characteristics for finish materials proposed for use to ensure compatibility of various parts.
2. Test compatibility of existing coating, including shop applied primers and previously applied coating, buy applying specified paint to small, inconspicuous area.
3. If specified paint lifts or blisters existing coating, apply barrier or tie coat as recommended by paint manufacturer.
4. If no compatible barrier or tie coat exists, remove existing coating completely and apply paint system as specified for new work.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Except for any special coatings specified or indicated elsewhere, provide painting products of one of the following manufacturers:

1. Basis of Design: Sherwin-Williams Co., Cleveland, OH
2. Benjamin Moore & Co., Montvale, NJ
3. Pittsburgh Paints, PPG Industries, Pittsburgh, PA

2.02 PAINT MATERIALS

A. General:

1. Provide manufacturer's first line professional quality paint/ coating materials for the coating systems specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
2. Paints: Ready-mixed, factory tinted, with the following characteristics:

   a. Fully ground pigments to maintain soft paste consistency in vehicle.
   b. Capable of being dispersed into uniform, homogeneous mixture.
   c. Possess good flowing and brushing properties.
   d. Capable of drying or curing free of streaks or sags, and yielding specified finish.
   e. Paints formulated with formaldehyde, halogenated solvents, mercury or mercury compounds, or tinted with pigments of lead, cadmium, chromium VI and their oxides not allowed.

      1) Water Based Paints formulated with aromatic hydrocarbons (organic solvent with benzene ring in its molecular structure) not allowed.
      2) Solvent Based Paints formulated with more than 10 percent aromatic hydrocarbons by weight not allowed.

   f. VOC content of field applied paints shall not exceed following limits after thinning. Values listed pounds per gallon.

      1) Architectural Paints, Flat Finish: 2.1.
      2) Architectural Paints, Finish other than Flat: 3.2.
      3) Industrial Maintenance Primers and Topcoats: 3.8.
      4) Metallic Pigmented Paints (Zinc Rich): 4.2.
      5) Stains, Clear and Semitransparent: 4.6.
      6) Stains, Opaque: 2.9.
      7) Stains, Low Solids: 1.0.
      8) Shellac, Clear: 6.1.
      9) Shellac, Opaque: 4.6.

2.03 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

2.04 ACCESSORY MATERIALS

A. Muriatic Acid, Mildewcide, TSP (Tri-Sodium Phosphate), Acidic-Detergent, Zinc Sulfate, Sodium Metasilicate, And Solvent: Commercially available, non-damaging to surface being cleaned; as specified in PDCA Specification Manual; acceptable to paint manufacturer.

B. Metal Conditioner: Proprietary phosphoric acid based, etching type solution; acceptable to paint manufacturer.

C. Rust Inhibitor: Water containing 0.32 percent of sodium nitrite and 1.28 percent by weight of secondary ammonium phosphate (dibasic); or water containing 0.2 percent by weight of chromic acid or sodium chromate or sodium dichromate or potassium dichromate.

D. Compounds: Spackling compound, putty, plastic wood filler, liquid de-glosser, latex patching plaster, latex base filler, thinners, and other materials not specifically indicated but required to achieve finishes specified. Pure, of highest commercial quality, compatible with paints and acceptable to paint manufacturer.

E. Provide related materials, such as linseed oil, shellac, turpentine, or other accessory materials of the highest quality approved for use by the manufacturer of the paint and used within paint manufacturers recommended limits.

2.05 MIXING

A. Use factory prepared colors matching approved samples. Site tinting is not permitted.

1. Thoroughly mix and stir paints before use to ensure homogeneous dispersion of ingredients. Prior to application, blend multiple containers of same material and color by pouring from one container to another several times to ensure uniform consistency, color, and smoothness.
2. Mix only in clean mixing pails of material recommended by manufacturer to avoid contamination.
3. Remove film which may form on surface of material in containers and strain material before using. Stir frequently during use to maintain pigments in suspension. Do not stir film into material.
4. Apply paints of consistency recommended by manufacturer. Thin only within recommended limits using thinners approved by paint manufacturer.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine substrates, areas, and conditions, with the applicator present, under which painting will be performed for compliance with paint application requirements.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Architect of anticipated problems in application, system specifications, or possible incompatibility of coatings over substrates which are pre-primed or primed by others.

C. Notify Architect a minimum of one working day prior to painting about possible problems resulting from using the specified materials over previously finished substrates.

D. Conduct alkali testing with litmus paper on exposed plaster, cementitious, and masonry surfaces, and do not begin painting if surfaces exceed alkalinity allowed by paint manufacturer.

E. Test moisture content of surfaces using an electronic moisture meter. Do not begin application of coatings unless moisture content of exposed surfaces is below the following maximum values:

1. Gypsum Wallboard: 12 percent.
2. Plaster: 12 percent.
3. Masonry Surfaces: 12 percent.
4. Finish Woodwork: 7 to 10 percent moisture content.
5. Wood Surfaces: 15 percent.
6. Vertical Concrete Surfaces: 12 percent.
7. Horizontal Concrete Surfaces: 8 percent.

F. Coordination of Work: Review other sections in which primers are specified to ensure compatibility for the total system with various substrates.

3.02 SURFACE-PREPARATION FOR NEW PAINTED SURFACES

A. General: Use the cleaning methods specified in this article, using the gentlest appropriate method necessary to clean the surface.

B. Wash surfaces by hand cleaning using clean rags, sponges, water, and detergent.

C. Hand-Tool Cleaning: Use wet sanding and wet scraping methods only. Lightly mist substrate before sanding or scraping. Acceptable hand-tools include scrapers, wire brushes, sandpaper, steel wool, nonmetallic pads, and dusters. Because of varying substrates, selection of tools shall be the responsibility of Contractor. After hand-cleaning is attempted, power tool cleaning may be required to complete cleaning and surface preparation.

D. Solvent Cleaning: Solvent cleaning may be used to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before preparation work begins. In addition, if necessary, spot-solvent cleaning may be employed just prior to the commencement of paint application, provided enough time is allowed for complete evaporation. Clean solvent and clean rags shall be used for the final wash to ensure that all foreign materials have been removed.

E. General:

1. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
2. Protect elements surrounding the work of this section from damage or disfigurement. Provide drop cloths, shields, and protection methods to prevent spray or droppings from disfiguring other surfaces.
3. Protect floors and adjacent work and materials. Remove and properly place temporary protection and coverings removed from the work area. Repair damage to other surfaces caused by work of this section.
4. Remove empty paint containers from the site. Dispose in accordance with local disposal requirements.

F. Clean and prepare substrate surfaces in accordance with manufacturer’s instructions for each particular substrate condition. Remove oil and grease before mechanical cleaning. Clean and correct defects and deficiencies in substrate surfaces to be painted before applying paint or finish treatments.

1. Do not paint over dirt, rust, scale, grease, oil, moisture, or marred surfaces, mildewed surfaces or other conditions detrimental to formation of a durable paint film.
2. Correct minor defects and clean surfaces which affect work of this Section.
3. Seal marks which may bleed through surface finishes.
4. Remove mildew by scrubbing with solution of tri-sodium phosphate and bl0each solution. Rinse with clean water and allow surface to dry thoroughly.
5. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

G. Shop Primed Steel and Ferrous Metal Surfaces:

1. Bare Metal Solvent Cleaning: Clean with solvents to remove oil, grease, and other contaminants before other cleaning treatments are used. Do not use solvents, including primer thinner and turpentine, which leave residue.
2. Shop Primed Steel Surfaces: Surfaces shall be clean and dry. Fill any open joints or deep abrasions in shop prime coat with filler, feather edges, sand smooth, and touch-up with metal primer compatible with shop primer, extending primer beyond treated area.
3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces; remove rust, oil, grease, dirt, and other foreign substances. Use removal or cleaning methods that comply with paint manufacturer's written recommendations.

    a. Touch up bare areas and prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as shop coat.

4. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents until surfaces are free of oil and surface contaminants.

    a. Pretreat surfaces prior to application of prime coat with phosphate pretreatment. Strictly follow manufacturer’s directions as to cleaning prior to treatment, application of treatment, and after-rinse.
    b. Thoroughly clean all surfaces receiving directly applied prime coat with solvent or chemical washes, to remove oil, grease and other film. Wipe dry with clean cloths. Prime with zinc oxide primer.

5. Conditioner (Apply to Bare Metal): Apply phosphoric acid-based, etching-type surface treatments after solvent cleaning and according to manufacturers' written instructions. Rinse with clear water when reaction is complete. Allow at least 15 to 30 minutes but not less time than recommended by manufacturer for metal conditioner to condition the metal surface. Do not allow conditioner to dry before rinsing. If white rust (zinc oxide) appears after drying, wash clean with denatured alcohol immediately before priming.

H. Concrete Block Masonry Surfaces and Monolithic Concrete:

1. Prepare surfaces by removing efflorescence, chalk, dust, dirt, grease, oils, and release agents dirt, dust, loose mortar, scale, salt or alkali powder, and oil or grease stains. Cracks, abrasions, and other defects shall be cut out, patched flush, and sanded smooth and sealed before applying prime coat.

    a. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before applying paint.

2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

    a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
    b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.

I. Concrete Floors:

1. Existing Floor Surfaces: Thoroughly clean surface of any substance that could interfere with the bond of the installation material, including dirt, paint, tar, asphalt, wax, oil, grease, latex compounds, form release agents, laitance, loose toppings, foreign substances and any other residues.

    a. If there is no evidence of efflorescence, scrub with mild detergent solution. Remove dirt and other foreign matter. Remove oil and grease by solvent cleaning.
    b. Concrete surfaces must be mechanically profiled and prepared by shot-blasting, sandblasting, waterjetting, scarifying or other engineer-approved methods to obtain profile. Reference ICRI CSP Standards for acceptable profile heights. Unless noted otherwise, create profile in existing surface by shotblast or grinding to achieve a surface profile equivalent to 100 grit sandpaper.

J. Wood to Receive Painted Finish:

1. Wood to be painted shall be back-primed on sides and edges. Use wood primer for back-priming, where opaque finish is specified.
2. Sand to a smooth even surface and then dust off. Sand surfaces showing raised grain smooth between each coat.
3. Wipe surface with a tack rag prior to applying finish.
4. Surface painted with an opaque finish:

    a. Coat knots, sap and pitch streaks with Knot Sealer before applying paint.
    b. Apply two coats of Knot Sealer over large knots.

5. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with wood filler paste. Sand the surface to make smooth and finish flush with adjacent surface.
6. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.
7. Fill open grained wood such as oak, walnut, ash and mahogany with Wood Filler Paste, colored to match wood color.

    a. Thin filler in accordance with manufacturer's instructions for application.
    b. Remove excess filler, wipe as clean as possible, dry, and sand as specified.

K. Gypsum Board:

1. New gypsum board must be clean and dry. All nail heads must be set and spackled. Joints must be taped and spackled and finished with joint compound. All dust must be removed prior to painting.
2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and wet sand; spot-prime with specified primer.

L. New Plaster, Patched Existing Plaster Surfaces:

1. New plaster shall be dried thoroughly at least 30 days before painting and shall be cured and hard. Repair damaged areas with appropriate patching material.
2. Fill minor cracks and defects in existing plaster with spackle compound; fill large cracks and defects with patching plaster. Acid wash or neutralize high alkalinity or “hot spots.” Prime all bare, filled and patched plaster with primer-sealer specified for new plaster. .
3. Neutralize surface of plaster with mild acid solution as recommended by paint manufacturer. In lieu of acid neutralization, provide manufacturer's written recommendation for plaster primer over alkaline plaster surfaces.

3.03 SURFACE PREPARATION FOR EXISTING PAINTED SURFACES

A. General: Remove hardware and hardware accessories, plates, machined surfaces, and similar items previously installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting. Protect floors, adjacent work and surrounding elements and materials.

1. Remove mildew by scrubbing with mildewcide. Rinse thoroughly with clean water.
2. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved. Remove protection and coverings.

B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Existing Surfaces: Condition, clean, sand, prime, seal and prepare existing surfaces per manufacturer’s recommendations for application of finish materials specified.
    a. Remove chalk deposits and loose, blistered, scaling, or crazed finish to bare base material or sound substrate by scraping and sanding.
    b. Repair imperfections, nail holes, and irregularities in substrate with filler or materials compatible with substrate. Fill paint loss on existing surfaces with filler or materials compatible with substrate and finish. Match surface texture of repair and filled areas to non-damaged adjacent surface.
    c. Wash surfaces with a solution of TSP to remove wax, oil, grease, and other foreign material; rinse and allow to dry.
    d. Abrade glossy surfaces by sanding or wiping with liquid deglosser.
    e. Remove mildew as specified above.
    f. Neutralize and prime repairs, filled areas and bare spots.
    g. Test compatibility of existing coatings by applying new paint to small, inconspicuous area. If new paints lift or blister existing coatings, request recommendation from Architect before proceeding.
    h. Provide finish coats only over existing surfaces except where condition or type of surface requires priming and sealing. Provide finish materials for existing surfaces same as new surfaces and as scheduled under Paint and Coatings Schedule.
2. Provide barrier coats over incompatible primers or remove and reprime.
3. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be re-painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze.
    a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
    b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
    c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

C. Wood to Receive Painted Finish:

1. Fill voids and nail holes using filler compatible with the finishing system. Sand between coats.
2. Sandpaper smooth or use liquid de-glosser to remove gloss and to provide a "tooth" for finish bonding. Prime bare spots with primer specified for new work. Fill all cracks, nail holes and other

irregularities using filler compatible with the finishing system. Provide colored filler material to match stain for transparent finishes. Sand smooth and flush with adjacent surfaces.

3. Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off. Confirm moisture level is below 12 percent before beginning paint work.

D. Metals to Receive Painted Finish:

1. Ferrous Metals: Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC/NACE) recommendations.

   a. Treat shop fabricated metals with sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

2. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

E. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

F. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

G. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.04 PROTECTION AND MASKING

A. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be finished and that have not been removed by others. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and finishing. After completing finishing operations in each space or area, reinstall items removed unless otherwise indicated.

B. Take particular care to protect the following:

1. Adjacent surfaces.
2. Masonry surfaces.
3. Metal surfaces.
4. Wood surfaces.

C. Protect elements to retain their original finishes from damage by paint or paint removal products. Mask, tape, and take great care when applying finish materials to areas adjacent to original finishes. Mask off building elements and equipment not to be finished with masking film or polyethylene sheeting adhered with preservation tape.

D. Safeguard the building’s lighting fixtures, floors, decorative art glass, stonework and equipment and materials to remain.

E. Protect areas retaining their original finishes from damage and overpaint.

F. Protect the work of other trades against any overpainting, marring, masking residue, or other damage.

G. If accessibility to surfaces is restricted, it is the paint contractor's responsibility to request that the obstructing materials be moved.

H. All trades shall be responsible for making good any damage for which they are responsible. Correct damage by cleaning, repairing, or replacing, and repainting, as acceptable to the Architect.

3.05 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied. Coat all surfaces specified, scheduled, illustrated, and otherwise exposed unless specifically noted otherwise.

1. Apply paint of type, color, and sheen as scheduled.
2. Number of coats specified is the minimum number acceptable.
3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
4. Provide finish coats that are compatible with primers used.
5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
6. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
7. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
9. Finish doors on tops, bottoms, and side edges the same as face surfaces.
10. Finish edges of paints adjoining other materials or colors sharp and clean, without overlapping.
11. Provide specified primer and finish coats on all surfaces of window frames and stops. Concealed ends and edges of window sashes are to receive primer and first coat of finish.
12. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
13. Sand lightly between each succeeding enamel or varnish coat.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the room treatment schedule or the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate a paint coating system for a particular substrate, defer to the Architect for selection of finish system and color.

1. Items such as doors and door frames that are exposed on two faces and which occur between two rooms or spaces are to be finished/ painted on both sides unless otherwise noted.
2. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
3. At any surface which is not scheduled to be painted, but which has be affected by cutting and patching or selective demolition, paint the surface with the pertinent coating system for the substrate type as scheduled in this section to the extent of the surface area. At walls, to inside or outside corners of the affected area; at ceilings to the extent of the ceiling area in each space.

C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer on metal surfaces that have been shop primed and touchup painted with compatible materials.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

D. Application Methods: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

E. Apply paint systems to total dry film thickness scheduled. Apply material at not less than manufacturer’s recommended spreading rate. Do not exceed maximum single coat thickness recommendation by paint manufacturer. Do not double-back with spray equipment by building up film thickness of two coats in one pass. Ensure that edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent of flat surfaces.

F. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

G. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

I. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.06 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Mechanical items to be painted include, but are not limited to, the following:

1. Piping, pipe hangers, and supports.
2. Heat exchangers.
3. Tanks.
4. Ductwork.
5. Insulation.
6. Motors and mechanical equipment.
7. Accessory items.
8. Shop primed equipment.
9. Shop primed finish items such as louvers, grilles, covers and other similar items.

B. Electrical items to be painted include, but are not limited to, the following:

1. Conduit, boxes and fittings.
2. Switchgear.
3. Panelboards.

C. Refer to Divisions 21, 22, 23, and 26 for schedule of color coating and identification banding of equipment, ductwork, piping, and conduit.

D. Paint shop primed equipment.

E. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately. Metal and/or plastic devices such as exposed raceways, fire horn and strobe, diffuser and grilles, radiators and cabinet heaters shall be spray painted.

F. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are indicated not to be finished.

G. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

H. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

I. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

3.07 FIELD QUALITY CONTROL

A. General: Comply with the requirements of Section 01 45 00 – Quality Control Requirements.

1. Periodically test film thickness of each coat with wet film gage to ensure paints are being applied to proper thickness.
2. Request review of each applied coat by Architect before application of successive coats.
3. Only reviewed coats will be considered in determining number of coats applied.
4. Immediately prior to Substantial Completion, perform detailed inspection of painted surfaces and repair or refinish abraded, stained, or otherwise disfigured surfaces.

3.08 DEFINITION OF SHEEN

A. General: Standard coating terms defined in ASTM D16 apply to this Section:

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Satin or Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

B. Sheens for surfaces to be painted in this section: are indicated in the finish schedule on the drawings:

3.09 CLEANING AND PROTECTION

A. Cleaning: Comply with Section 01 77 00 – Closeout Procedures. Promptly remove spilled, splashed, or spattered paints. Clean spots, oil, and other soiling from finished surfaces using cleaning agents and methods which will not damage materials.

1. If completed construction is damaged beyond normal cleaning or repair by painting operations, replace damaged items at no additional cost to GSA.
2. Maintain premises and storage areas free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
3. Collect waste, cloths, and material which may constitute fire hazards and place in closed metal containers; remove from site daily along with empty containers.

B. Protection: Protect finished work in accordance with Section 01 50 00 – Temporary Facilities and Controls.

1. Protect work of other trades against damage from paint activities. Correct damage by cleaning, repairing, replacing, and repaint as acceptable to the Architect.
2. Provide "Wet Paint" signs and other methods to protect newly coated surfaces. Remove when directed or when no longer needed.

3.10 EXTERIOR PAINTING SCHEDULE

A. Note: Coatings for Exterior Metal surfaces specified in Section 09 96 00 – High Performance Coatings.

3.11 INTERIOR PAINT AND COATING SCHEDULE

A. Schedule: Provide products and number of coats specified. Use of manufacturer's proprietary product names to designate colors, materials, generic class, standard of quality and performance criteria and is not intended to imply that products named are required to be used to the exclusion of equivalent performing products of other manufacturers.

B. Concrete Masonry Surfaces:

1. 1 coat SW PrepRite Block Filler B25W25
   2 coats Sherwin-Williams: ProMar 200 Zero VOC Latex Eg-Shel Enamel B20-2600 Series
2. 1 coat BM Ultra Spec® Masonry Interior/Exterior Hi-Build Block Filler (571) (45 g/L)
   2 coats BM Ultra Spec 500 Interior Latex Flat N536 (0 g/L)
3. 1 coat PPG: SPEEDHIDE® Int./Ext. Masonry Hi Fill Latex Block Filler 6-15XI
   2 coats PPG: SPEEDHIDE® Interior Enamel Latex Semi-Gloss 6-500 Series

C. Shop Primed Metal: Interior Hollow Metal Doors, Frames, and other Ferrous Metal Surfaces for semi-gloss finish:

1. First Coat: Primer (NOTE: Primer also required on galvanized surfaces. All shop primed surfaces shall be reprimed with proper primer per manufacturer's instructions prior to applying coatings scheduled herein).
2. Interior Latex Enamel: Factory-formulated latex enamel for interior applications:

   a. 1 coat S-W; ProCryl Universal Metal Primer B66W310 Applied at a dry film thickness of not less than 3.0 mils
      2 coats S-W; ProMar200 Interior Water Based Acrylic Alkyd Semi-Gloss Enamel B34-8251 Series: Applied at a dry film thickness of not less than 1.7 mils
   b. 1 coat: BM Super Spec® HP Acrylic Metal Primer P04 (47 g/L)
      2 coats: BM Ultra Spec D.T.M. Acrylic Gloss Enamel HP28 (142 g/L)
   c. 1 coat: PPG; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mils
      2 coats: PPG; 6-1510 Series Speedhide Alkyd WB Gloss Enamel

D. Gypsum Board Substrates: (Eggshell sheen)

1. 1 coat BM Ultra Spec 500 Interior Latex Primer N534 (0 g/L)
   2 coats: BM; Ultra Spec 500 Latex Eggshell N538 (0 g/L)
2. 1 coat PPG: "Speedhide zero Interior Zero VOC Latex Sealer 6-4900XI." (0 g/L)
   2 coats PPG: "Speedhide zero Interior Zero VOC Latex Eggshell 6-4310XI Series." (0 g/L))
3. 1 Coat: S-W ProMar 200 Interior Latex Wall Primer, B28W8200, (4 mils wet, 1.3 mils dry per coat).
   2 Coats: S-W ProMar 200 Acrylic Latex Egg-Shell Enamel B20W200, (4 mils wet, 1.6 mils dry per coat)

E. Gypsum Board Ceilings: (Flat Sheen)

1. 1 coat Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534 (0 g/L)
   2 coats: Benjamin Moore; Ultra Spec 500 Interior Latex Flat N536 (0 g/L)
2. 1 coat PPG: "Speedhide zero Interior Zero VOC Latex Sealer 6-4900XI." (0 g/L)
   2 coats PPG: "Speedhide zero Interior Zero VOC Latex Flat 6-4110XI." (0 g/L)
3. 1 coat: S-W ProMar 200 Interior Latex Wall Primer, B28W8200, (4 mils wet, 1.3 mils dry per coat)
   2 coats: S-W ProMar 200 Interior Latex Flat Wall Paint, B30 Series, (4 mils wet, 1.6 mils dry per coat)

F. Gypsum Board: (Semi-Gloss sheen)

1. 1 coat: Benjamin Moore: "Benjamin Moore Ultra Spec 500 Interior Latex Primer N534 (0 g/L)
   2 coats: Benjamin Moore: "Ultra Spec 500 Interior Latex Semi-Gloss N539 (0 g/L)
2. 1 coat: PPG: "Speedhide Interior Latex Sealer Quick Drying 6-2." (<50 g/l)
   2 coats: PPG: "Speedhide Acrylic Latex Semi Gloss Enamel 6-500 Series." (<50 g/l)
3. 1 coat: S-W: "ProMar 200 Interior Latex Wall Primer, B28W8200" (<100 g/l)
   2 coats: S-W: "ProMar 200 Acrylic Latex Semi Gloss Enamel B31W2600 Series." (<150 g/l)

G. Wood and Hardboard: Provide the following paint finish systems over interior wood surfaces:

1. Semi-Gloss Finish: Two finish coats over a wood undercoater.

a. 1 Coat: S-W PrepRite ProBlock Latex B51 Series: Applied at a dry film thickness of not less than 1.4 mils (4 mils wet).
2 Coats: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series: Applied at a dry film thickness of not less than 1.7 mils per coat (4 mils wet).
b. 1 Coat –BM Fresh Start Multi-Purpose Primer (023)
2 coats: BM Advance Waterborne Alkyd Finish Satin (792), Semi-Gloss (793), High Gloss (794
c. 1 coat: PPG SEAL GRIP® Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI
2 coats PPG: SPEEDHIDE® Interior Enamel Latex Semi-Gloss 6-500

H. Ferrous and Galvanized Metal at Exposed Ceiling Construction including Ductwork, Conduits, and Piping (Not less than 10 feet AFF):

Note: Verify color with Architect.

1. 1 Coat: S-W DTM Acrylic Primer/Finish B66W1: Applied at a dry film thickness of not less than 2.5 to 4 mils.
2 Coats: S-W Waterborne Acrylic Dry Fall Eg-Shel B42W2: Applied at a dry film thickness of not less than 3.0 mils (7 mils wet)
2. 1 coat: BM: Super Spec® HP Acrylic Metal Primer P04
2 coats: BM: “Dryfall Latex Flat 395 (46 g/L),)
3. 1 Coat: PPG PITT-TECH® Plus Waterborne DTM Acrylic Primer Finish 4020PF. Applied DFT not less than 2.5-4 mils
2 Coats: PPG SPEEDHIDE® SUPER TECH® WB Interior 100% Acrylic Dry-Fog Eggshell Latex 6-724XI. applied not less than 3.0 mils

I. Lining of Mechanical Equipment, Convector Cabinets, Unit Ventilators or Ducts Visible Through Grilles or Louvers:

1. 2 coats SW Industrial Enamel, B54 Series; Black.
2. 2 coats BM Satin Impervo Enamel (235); Black.
3. 2 coats PPG HPC Rust Preventative High Gloss Alkyd Enamel 4309; Black

J. Exposed Insulated Piping, Ductwork, Vessels:

1. 1 coat Sherwin-Williams; PrepRite Masonry Primer B28W300: Applied at a dry film thickness of not less than 3.0 mils
2 coats SW (Finish same as adjoining walls or ceiling)
2. 1 coat Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils
2 coats BM (Finish same as adjoining walls or ceiling).
3. 1 coat Pittsburgh Paints; PPG 17-921 Seal Grip Primer
2 coats PPG (Finish same as adjoining walls or ceiling)

K. Exposed Uninsulated Piping: Interior Semigloss Alkyd Enamel: Factory-formulated semigloss alkyd enamel for interior application.

1. 1 coat S-W Kem Bond HS Alkyd Universal Metal Primer Applied at a dry film thickness of not less than 3.0 mils
2 coats S-W (Finish same as adjoining walls or ceiling)
2. 1 coat BM; Moore’s IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils
2 coats BM (Finish same as adjoining walls or ceiling).
3. 1 coat PPG Multiprime 4360 Low VOC Alkyd Corrosion Resistant Primer. Applied at a dry film thickness of not less than 2.0 mils.
2 coats PPG (“Finish same as adjoining walls or ceiling”)

L. Interior Structural Steel: Semigloss Alkyd Enamel: Factory-formulated semigloss alkyd enamel for interior application:

1. 1 coat SW Kem Bond HS Alkyd Universal Metal Primer Applied at a dry film thickness of not less than 3.0 mils
2 coats SW (Finish same as adjoining walls or ceiling)
2. 1 coat Benjamin Moore; Moore’s IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils

2 coats BM (Finish same as adjoining walls or ceiling)

3. 1 coat PPG Multiprime 4360 Low VOC Alkyd Corrosion Resistant Primer. Applied at a dry film thickness of not less than 2.0 mils
   2 coats PPG (Finish same as adjoining walls or ceiling)

M. Mechanical and Electrical Work: Paint all exposed items throughout the project except factory finished items with factory-applied baked enamel finishes which occur in mechanical rooms or areas, and excepting chrome or nickel plating, stainless steel, and aluminum other than mill finished. Paint all exposed ductwork and conduits: Coating systems as specified.

END OF SECTION

SECTION 09 97 23

CONCRETE SEALER

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes colorless sealer compound for new and existing exposed interior concrete slabs with steel trowel finishes as scheduled on drawings. Coordinate with Section 03 30 00 – Cast-in-Place Concrete and the following:

B. Related Sections:

1. Schedule of Finishes on the drawings.

1.02 ACTION SUBMITTALS

A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's specifications and application instructions for each product. Include data substantiating that materials are recommended by manufacturer for applications indicated. Include the following information for installation instructions:

1. Environmental conditions, including temperature, relative humidity, wind conditions and sun exposure under which materials may be applied.
2. Methods and equipment which will be used in application of curing and sealer.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

B. Applicator's Qualifications: Engage an experienced Applicator who employs only persons trained and approved by curing and sealer manufacturer for application of products and issuance of special warranty.

C. Manufacturer Qualifications: Provide products produced by a company that has successfully specialized in production of this type of work for not less than 5 years.

D. Field Sample: Prior to installation of work of this Section, apply coating sample at location directed by or acceptable to the Architect, using specified materials and illustrating finish and workmanship to be expected in the completed work. Retain mockup that has been approved by the Architect until the work has been completed and accepted.

1. Configuration: Approximately 4 feet by 4 feet.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.04 DELIVERY, STORAGE AND HANDLING

A. General: Comply with requirements specified in Section 01 60 00 – Product Requirements.

B. Deliver materials to site in sealed, original, labeled containers bearing manufacturer's name, type of material, brand name, and instructions for mixing. Store materials off-ground, and under cover. Conform to any additional recommendations of the manufacturer regarding storage and handling of the materials.

C. Architect reserves the right to inspect the containers prior to their opening, to review accompanying bills of lading, and to reject materials in opened containers.

1.05 PROJECT CONDITIONS

A. Environmental Requirements: Do not proceed with installation until areas to receive the work have been enclosed and until temperature and relative humidity have been stabilized and will be maintained within values established by the manufacturer for optimum quality control.

1.06 WARRANTY

A. General: Refer to Division 01 for additional requirements.

B. Dustproofer and Sealer Warranty: Furnish manufacturer's single source labor and materials warranty, signed by an officer of the manufacturing company, for a period of ten (10) years for concrete surfaces. Warranties shall start on date of Substantial Completion. Include in warranty the following:

1. Failure of the dustproofer and sealer to retain its dustproofer capability caused by defective material, from application or from the ordinary wear and tear.
2. Failure of dustproofer and sealer to prevent damage to concrete evident within the warranty period.
3. Warranty shall not be limited to the original cost of materials and labor.
4. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 – PRODUCTS

2.01 CONCRETE SEALER

A. Water Based Acrylic Sealing Compounds:

1. ASTM C1315, Type I, Class A, VOC compliant, free of natural or petroleum waxes. Dries clear with satin sheen.
2. VOC Requirement: Less than 100 g/L
3. Acceptable Products:

a. Diamond Clear, Euclid Chemical Co., Cleveland, OH
b. Lumiseal WB Plus, L&M Construction Chemicals, Inc., Omaha, NE.
c. VOCOMP-30, WR Meadows, Inc., Hampshire, IL.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions affecting performance and conditions of floor treatment with requirements for maximum moisture content. Verify concrete slabs are flat, level, and dry.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter for concrete: 12 percent.
2. Verify compatibility with and suitability of substrates, including existing finishes or primers. Verify if plasticizers, if any, in existing concrete substrate will not impair bond.
3. Commence application after unsatisfactory conditions are corrected and surfaces are dry.
4. Commencement of floor treatment application indicates acceptance of surfaces and conditions.
5. Perform tests recommended by manufacturer. Proceed with installation after substrates pass testing.

3.02 PREPARATION

A. Clean substrate, removing projections and substances detrimental to the work; comply with recommendations of manufacturer for preparation procedures. Mask off or protect adjacent surfaces not scheduled to receive sealer.

B. Concrete Substrates: Prepare and clean substrates according to manufacturer's written instructions.

1. Clean substrates of substances that impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants. Neutralize plasticizers that cannot be removed.
2. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
3. Remove incompatible primers and reprime substrate with compatible primers as required
4. Remove laitance, glaze, curing compounds, form release agents, dust, dirt, grease, Oil, and contaminants that impair bond. Remove contaminants using mechanical Means.
5. Treat nonmoving substrate cracks and control joints to prevent cracks from telegraphing (reflecting) through flooring according to manufacturer's written recommendations.

6. Protect substrate voids and joints to prevent flooring resins from flowing into or leaking through them.
7. Protect walls, floor openings, equipment inserts, electrical openings, door frames, and Obstructions during installation. Cover floor and wall areas at mixing stations.

3.03 APPLICATION

A. General: Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.

B. Concrete Sealer: Spray apply sealer system components according to manufacturer's written instructions.

3.04 PROTECTION

A. Institute protective procedures and install protective materials as required to ensure that work is without damage or deterioration at Substantial Completion. Protect adjacent work against damage from concrete flooring treatment. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities and before Substantial Completion, touch up and restore damaged or defaced treated surfaces.

END OF SECTION

SECTION 10 11 00

DRY-ERASE BOARDS AND TACKBOARDS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes dry-erase boards, tackboards, trim, adhesives, installation devices, and accessories.

B. Related Sections:

1. Section 09 29 00 – Gypsum Board.

1.02 ACTION SUBMITTALS

A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Complete shop drawings by approved manufacturer for proposed boards and panels, including unit compositions, trims, accessories, and perceived locations upon walls.

C. Complete suitable color selection materials (sample chart, card, etc.) in triplicate quantity for proposed markerboard, and multi-media board surfaces and proposed vinyl fabrics and corks.

D. Specific project certification from manufacturer assuring full compliance with 25 flame spread rating (per ASTM E84) for proposed mounted tackboard assemblies and tackable wall surfaces in affected areas (such as corridors and other means of egress).

1.03 REFERENCED STANDARDS

A. ASTM International:

1. ASTM E84-00 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.04 QUALITY ASSURANCE

A. Units shall be factory assembled.

1.05 WARRANTY

A. Manufacturer shall warrant visual display boards to be free from defects in material and workmanship for a period of 5 years from the date of Substantial Completion.

1. Wear: Fading of color, crazing, cracking or flaking: 5 years

B. Manufacturer shall guarantee that porcelain enamel face sheets on markerboards, and multi-media boards will retain original writing and erasing qualities for the life of the building.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Products of the following manufacturers will be considered, providing their products equal or exceed the quality specified; and they can provide products of the type, size, function, and arrangement required.

1. Claridge Products and Equipment
2. Ghent, a GMi Company
3. Clarus
4. Nelson/Adams (NACO)

2.02 DRY ERASE BOARDS

A. Shall have 24 gauge porcelain enamel steel face with backer board in extruded aluminum frame with marker tray and head tackstrip. Finish shall be manufacturer's standard glossy white. Core shall be at least 1/2 inch thick particleboard or fiberboard material backed by either foil or aluminum for moisture seal.

2.03 MARKERBOARDS AND TACKBOARDS

A. Types: Factory built, fixed units.

B. Height of markerboards, and tackboards shall be 4 feet, unless otherwise indicated.

C. Provide individual and combination markerboard and tackboard units as indicated.

D. Markerboard, and Multi-Media Board Construction:

1. Markerboard face sheet shall be 24 gauge liquid writing surface (LCS) board.
2. Core material and other requirements and accessories are as follows:

   a. 3/8 inch thick minimum Industrial Grade particleboard.
   b. .005 inch aluminum foil backing.
   c. Porcelain face sheet, Class A titanium frit.
   d. M.O.H. porcelain hardness: 6.5.
   e. Markerboard and multi-media board color shall be as selected by Architect from not less than 4 standard colors.

2.04 TACKBOARDS

A. Tackboards: Shall be 1/8 in. thick composition cork mounted to 3/8 in. hardboard covered with 34 oz. self-healing vinyl in extruded aluminum frame.

B. Tackboard Construction:

1. Factory built, fixed units, vinyl covered tackboards with the following characteristics:

   a. 3/8 inch thick minimum Industrial Grade fiberboard core material.
   b. Provide single one-piece units wherever possible. Where lengths indicated exceed manufacturer's standard maximum length, provide a grouping of complete individual factory-built units of sizes to equal the total length indicated, composed of the minimum number of units. Number, length, and locations of units shall be as approved by the Architect.

      1) Color shall be as selected by Architect from not less than 6 standard colors.

2.05 TACKSTRIPS

A. Tackstrips shall be 1/4 inch thick composition cork in extruded aluminum frame. Width of tackstrip shall be 1 in. at dry erase board installations and 2 inch elsewhere.

2.06 TRIM AND ACCESSORIES

A. Furnish standard continuous box-type aluminum marker tray with slanted front and cast aluminum end closures for each dry erase board.

B. Trim: Shall be extruded aluminum, heavily anodized on exposed surfaces, with natural satin finish. Provide continuous extruded aluminum hanger bars and 2 inch angle hangers for units. Top rail of markerboards to be standard 2 inch map rail with natural cork insert.

1. Provide the following accessories for each individual markerboard unit.

   a. 4 spring clip hooks (metal)
   b. 2 roller brackets
   c. 2 map rail ends

2. Trim shall be same thickness as particleboard. Shimming of trim is not permitted.

2.07 WALL ATTACHMENT

A. Markerboard, and Tackboard Fasteners as follows:

1. CMU: Butterfly bolts into block core
2. Drywall: Metal screws into metal stud system
3. CMU and Drywall: Adhesive as recommended by manufacturer.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install markerboards and tackboards level and plumb with suitable screw attached, continuous extruded aluminum angle hanger bars at heads and 2 inch long extruded aluminum angle hangers spaced 16 inches apart at troughs, along with adhesive spots approximately 16 inches apart each way.

B. Secure tackable wall surface to wall with adhesive spots approximately 12 inches apart each way. Panels shall be blocked in place for sufficient length of time to develop proper bond.

C. Where two or more units are indicated on the same wall surface, install units end to end without visible space between units.

3.02 CLEANING

A. Clean surfaces and trim on markerboards and tackboards on completion of installation. Tackboards shall have surfaces thoroughly cleaned of discolorations, blemishes, or other imperfections.

END OF SECTION

SECTION 10 14 00

INTERIOR SIGNAGE

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes interior signs and attachment material including the following.

1. Interior signage required by code, including but not limited to emergency egress maps, fire related signage, restrooms and occupancy.
2. Directional signage.
3. Room name and number signs.

B. Related Documents:

1. Refer to Signage schedule and details on the drawings.

1.02 ACTION SUBMITTALS

A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.

B. Submit sign schedule to Architect for final approval prior to fabrication.

C. Submit shop drawing listing sign styles, lettering and locations, mounting methods, and overall dimensions of all project signage. Drawings for individual letters should indicate proposed spacing.

D. Submit available colors for all products.

E. Submit manufacturer's installation instructions for each sign type and material. Include installation template and hardware.

1.03 QUALITY ASSURANCE

A. ADA compliant containing tactile symbols, raised lettering and Grade 2 braille.

B. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and protect products in protected location prior to installation.

B. Package signs, labeled in name groups.

C. Products shall remain in manufacturer's protective wrappings and shall bear identification of manufacturer.

D. Store adhesive tape at ambient room temperatures.

PART 2 – PRODUCTS

2.01 INTERIOR SIGNAGE MATERIAL

A. Signage shall be manufactured from 1/16 in. clear matte acrylic that is sub- surface printed with a background color and laminated to a 1/16 in. opaque white or black acrylic base and has 1/16 in. raised acrylic letters,

1. Basis of Design : _____.
2. All signage shall comply with the ICC / ANSI A117.1 or current edition, making buildings and facilities accessible to and usable by persons with disabilities, Chapter 18, Signage. All signage must have the written information under the pictograms in order to comply with the current accessibility code. Signage shall meet current code if different from above. Interior signs shall be installed with mechanical fasteners.
3. All exposed edges on acrylic signs shall be sanded smooth.

4. Raised characters and graphics shall be painted in contrasting color.

B. Font: As selected, upper and lower case or all capital letters with letter heights as indicated on architectural drawings, and Owner's signage standards. Text as indicated in the sign schedule.

C. Braille: Grade II Braille shall be provided.

1. Braille cells should be dome topped for ease of readability and be the same color as the background.
2. Sign manufacturer is responsible for assuring accuracy of spelling.
3. Braille for numbers is directly to the right on same line. Start ¼ inch from edge of last number.
4. For copy Braille is centered horizontally directly below the word.

D. Mounting Accessories: Provide as required and recommended by signage manufacturer for a complete installation. Install signs at dimensions indicated on drawings.

E. Adhesives and Fasteners: Type recommended by the signage manufacturer to meet specified general and structural support criteria. Exact identification of adhesives and fasteners shall be noted on shop drawings, including data describing method of application.

2.02 INTERIOR IDENTIFICATION SIGNAGE

A. Refer to signage schedule on the drawings.

PART 3 – EXECUTION

3.01 SIGNAGE INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install signs after doors and walls are finished, in locations indicated. Where locations are to be determined in the field, the Contractor shall consult with the Architect prior to beginning installation.

1. For signs to be mounted on walls, mechanically secure signs near corners with vandal-resistant fasteners. Fastener head color/ finish should match the field color of the signage.
2. Interior signs mounted on glass: Attach with high-strength double-sided tape (such as 3M products) for this purpose. Where backs of signs would show thru the glass, signage contractor must provide matching blanks plates taped to the opposite side of glass to conceal the mounting of the primary signage.

C. Refer to schedule and drawing for mounting locations. Unless otherwise noted, signs will occur outside of the room listed.

1. Verify all locations and heights with the Architect.
2. Clean and polish signage, and protect units from damage.

3.02 SIGN SCHEDULE

A. This preliminary sign schedule shall be reviewed and approved by the Owner prior to fabrication. Refer to drawings for location by Sign Tag.

END OF SECTION

SECTION 10 21 00

TOILET COMPARTMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes phenolic-core toilet compartments configured as toilet enclosures and including the following:

1. Floor anchored/overhead braced partitions.
2. Operating hardware and attachment hardware.

B. Related Sections:

1. Section 06 10 00 – Rough Carpentry: Blocking.
2. Section 09 29 00 – Gypsum Board
3. Section 09 30 00 – Tiling
4. Section 10 28 13 – Toilet Accessories: for accessories mounted to toilet partitions.
5. Schedule of Finishes and Legend on the drawings.

1.02 REFERENCES

A. American National Standards (ANSI): ICC/ANSI A117.1 - Accessible and Usable Buildings and Facilities.

B. National Electrical Manufacturer's Association (NE MA): NEMA LD3 - High Pressure Decorative Laminate

1.03 SUBMITTALS

A. Product data: Manufacturer's catalog cuts of typical panel, pilaster, door, hardware, accessory and fastening.

B. Submit shop drawings indicating partition plan and elevation views, dimensions, details of wall and floor supports, door swings, and instructions for installation of anchorage devices built into other work.

1. Show ceiling grid and overhead support or bracing locations.

C. Sample Warranty: Meet or exceed provisions specified by this Section. Include manufacturer's exclusions and limitations.

1.04 REFERENCES

A. ICC A117.1 – Accessible and Usable Buildings and Facilities.

1.05 QUALITY ASSURANCE

A. Components of toilet partitions shall be sourced from one single source manufacturer who certifies that materials meet or exceed specifications.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25-75.
2. Smoke-Developed Index: 450 or less.

1.06 PROJECT CONDITIONS

A. Take field measurements prior to preparation of shop drawings and fabrication, to ensure proper fitting of work.

B. Verify that adequate blocking exists. If necessary, furnish inserts and anchorages which must be built into other work for installation of toilet partitions and related work; coordinate delivery with other work to avoid delay.

C. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the project site in the manufacturers original containers with labels indicating brand names, colors and quality designations, legible and intact.

B. All doors, panels and pilasters shall arrive at the job site with factory applied protective masking.

C. Store and protect accepted materials in accordance with the manufacturer's direction and recommendations.

1.08 WARRANTY

A. Manufacturer: Minimum 15 year Warranty against defects in materials and workmanship, including warping and delamination of partition panels.

B. Manufacturer shall provide a 5-year warranty for all chrome hardware, and a lifetime warranty for stainless steel hardware.

PART 2 – PRODUCTS

2.01 MANUFACTURER – PHENOLIC-CORE UNITS

A. Manufacturer:

1. Basis-of-Design: Specifications are based on overhead-braced, ASI Global products "Color-Thru" toilet partition system.

B. Products of the following manufacturers will be considered, providing their products equal or exceed the quality specified; and they can provide products of the type, size, function, and arrangement required:

1. General Partitions
2. Scranton Products.
3. Bradley.
4. Metpar.

C. Toilet-Compartment Style: Floor-mounted, overhead braced.

2.02 PANEL COMPONENTS

A. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch-thick doors, minimum ¾ inch thick pilasters and minimum 1/2-inch-thick panels.

1. Resistant to delamination, water, steam, corrosion, soaps, detergents, and mildew.
2. Edges: Black solid phenolic resin, radiused and polished.
3. Fire hazard: Class B in accordance with ASTM E84 with 35 maximum flame spread and 100 maximum smoke development.

B. Pilaster Shoes: Fabricated from stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

C. Headrail (Overhead Brace): Heavy duty construction, extruded aluminum, anti-grip profile, approximately 1/8 inch thick, clear anodized finish.

D. Mounting Bracket Panel Fasteners:

1. Face Panels: Factory installed stainless steel or brass threaded inserts and machine screws with one-way security heads, except for concealed fasteners.
2. Side Panels: Through-bolted stainless steel, one-way threaded bolts and barrel nuts.

E. Hardware Fasteners: Standard screws with threaded inserts or through-bolted stainless steel, one-way threaded bolts and barrel nuts.

F. Furnish hardware to be built into other construction, such as inserts, anchors, and tie rods in timely manner to prevent delay.

2.03 COMPARTMENT HARDWARE

A. Hardware: Heavy-duty institutional quality hardware and fasteners necessary to complete the installation shall be provided.

1. Brackets: Continuous heavy duty anodized extruded aluminum (6063-T5 alloy) wall brackets, mounted with stainless steel screws.
2. Hinges: Continuous piano hinge, stainless steel. The closing position of each hinge shall be fully adjustable.

B. Outswing Doors: Spring loaded, self-closing.

C. Fasteners: Standard bolts, predrilled holes, brass inserts maximum 8 inch centers.

D. Sliding Door Latch:

1. Slider: Minimum 14 gauge Type 304 stainless steel or heavy cast stainless steel on nylon track.
2. Keeper: Minimum 8 gauge Type 304 stainless steel, one piece design.
3. Door Bumper: Rubber, located on latch.

E. Door Stops: Two 11 gauge stainless steel or heavy duty cast stainless steel, vinyl coated.

F. Clothes Hook: Specified for type and quality. Stainless steel cast or welded fabrication with rubber tipped bumper. One per stall.

G. Other Partition Mounted Toilet Accessories: Specified Section 10 28 13.

2.04 FABRICATION

A. Conform to following and ICC/ANSI A117.1for ambulatory accessible and wheelchair accessible compartments.

B. Toilet Compartment Dimensions:

1. Bottom of Panel: 12 inch above floor.
2. Top of Panel: 70 to 72 inch above floor.
3. Compartment Width: As shown on Drawings, except no less than 34 inches on center.

C. Toilet Compartment Doors: Minimum 24 inch wide, swing-in, except minimum 36 inch wide swing out doors at accessible compartments. Doors to stand slightly open when not in use.

D. Stabilizer Bars: 3 inch wide by 1 inch phenolic panel lateral bracing between compartments, mounted continuously across front of toilet compartments and fastened into pilasters

E. Pilasters: Cover floor mounted anchoring devices with pilaster shoe. Make maximum width to suit installation clearances. 8 to 12 inches preferred.

2.05 FINISHES

A. Refer to Interior Finish Schedule on the drawings.

B. Partition edge: Black or brown phenolic core, polished smooth, eased.

C. Stainless Steel: No. 4 Satin finish.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.

B. Verify spacing of plumbing fixtures and drains.

C. Verify correct location of built-in framing, anchorage, and bracing, where required.

D. Beginning of installation means acceptance of existing surfaces.

3.02 INSTALLATION

A. Install partitions and screens secure, plumb, and level and in accordance with manufacturer's instructions. Secure stiles to supporting structure.

B. Maintain 3/8-inch to 1/2-inch space between wall and panels and not more than 1 inch between wall and end pilasters.

C. Pilasters shall be rigidly fastened to floor and with pilaster leveling nuts. Attach panel brackets securely to walls using anchor devices. Verify location of blocking within metal framed walls to assure positive anchorage of anchors into blocking.

D. Attach panels and pilasters to bracket with through sleeve tamperproof bolts and nuts.

E. Equip each door with two hinges, one door latch, and bumper.

F. Install door strike and keeper with door bumper on each pilaster in alignment with door latch.

G. Adjust hinges to locate doors in partial opening position when unlatched. Return outswing doors to close position.

H. No evidence of drilling, cutting or patching shall be visible in the finished work.

3.03 ADJUSTING/CLEANING

A. Adjust, lubricate, and align hardware to uniform clearance at vertical edge of doors, not exceeding 1/4-inch.

B. Remove protective maskings. Clean surfaces.

C. Replace damaged or scratched materials with new materials.

D. Protect installation during remainder of construction.

END OF SECTION

SECTION 10 22 26

OPERABLE PANEL PARTITIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes operable partitions, including but not limited to the following:

1. Folding panel acoustical partitions, hinged pair panels, manual operation.
2. Ceiling track, hangers and operating hardware.
3. Shop-applied surface finish.

B. Related Sections/Drawings:

1. Interior Finish Legend on the drawings.
2. Section 05 12 00 – Structural Steel: Structural support for folding panel partition.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM E84 – Surface Burning Characteristics of Building Materials.
2. ASTM E90 – Airborne Sound Transmission Loss of Building Partitions.

1.03 ACTION SUBMITTALS

A. Prepare submittals in accordance with under provisions of Section 01 30 00 – Submittal Procedures.

B. Shop Drawings: Indicate opening sizes, track layout, details of track and template drawings for items support or anchored to permanent construction, track loads, adjacent construction and finish trim, and stacking sizes.

C. Product Data: Describe partition operation, hardware and accessories, track switches, colors and finishes available.

D. Samples: Two samples of surface finishes, 12 x 12 inches in size, illustrating quality, color, texture, and weight.

E. Manufacturer's Installation Instructions: Include specific installation sequence, and special instructions.

1.04 QUALITY ASSURANCE

A. Installer: Firm with not less than 3 years of successful experience in the installation of units similar to those required for this project and which is acceptable or licensed by manufacturer of folding partitions.

B. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions

C. The partition STC (Sound Transmission Classification) shall be achieved per the standard test methods ASTM E90.

D. Flame Spread Rating: Use only facing materials which have a flame spread rating of 25 or less when tested in accordance with ASTM E84.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Describe cleaning materials detrimental to vinyl surfaces and hardware finish.

C. Include recommended cleaning methods, cleaning materials, and stain removal methods.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Proper storage of partitions before installation and continued protection during and after installation will be the responsibility of the Contractor.

1.07 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on the shop drawings.

1.08 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Provide No dollar limit Warranty is for entire system including: track, trolley, panels, seals, hardware (not finishes) covering all direct and indirect costs except labor.
2. Failures include, but are not limited to, the following:
    a. Faulty operation of operable panel partitions.
    b. Deterioration of metals, metal finishes, and other materials beyond normal use.
3. Warranty Period: 10 years from date of Substantial Completion.
4. An additional warranty shall be provided by the vendor for a period of 2 years from the date of substantial completion to cover installation/labor.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:

1. Basis of Design: Moderco Partitions

B. Acceptable Manufacturers/Fabricators and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers/fabricators offering products that may be incorporated into the Work include but are not limited to those listed.

1. Kwik-Wall Company
2. Advanced Equipment

2.02 COMPONENTS – FOLDING PANEL PARTITION

A. Partition Construction: Nominal 4 inch thick panels in manufacturer's standard widths; panel construction tested in accordance with ASTM E84 test procedure for Class "A" Flame Spread Rating.

1. Panel faces shall be laminated to appropriate substrate to meet the STC requirement.
2. Frames shall be of 16 gauge painted steel with integral factory applied aluminum vertical edge and face protection.
3. Vertical sound seals shall be of tongue and groove configuration, ensure panel-to-panel alignment and prevent sound leaks between panels.
4. Horizontal top seals shall be retractable, provide 1” nominal operating clearance, and exert upward force when extended. All panels, including pass door panels and lever closure panels must have retractable top and bottom seals.
5. Horizontal bottom seals shall be retractable, provide up to 2” nominal operating clearance, and exert downward force when fully extended.
    a. Horizontal bottom seals shall be retractable, provide 4” nominal operating clearance, and exert 97 lbs. downward force when fully extended.
    b. Horizontal bottom seals shall be fixed continuous contact 4-finger vinyl.
6. Weight of the panels shall be 7.8-13.6 lbs./sq. ft. based on options selected.
7. Suspension system:
    a. Track shall be of clear anodized architectural grade extruded aluminum alloy 6063-T6. Track design shall provide precise alignment at the trolley running surfaces and provide integral support for adjoining ceiling, soffit, or plenum sound barrier. Track shall be

connected to the structural support by pairs of minimum 3/8" [10] dia. threaded steel hanger rods.

b. Each panel shall be supported by two 2-wheeled counter-rotating horizontal carriers. Wheels to be of precision ground steel ball bearings with heat treated and hardened races encased with molded polymer tires.

8. Panel Finish: Factory applied reinforced vinyl fabric with woven backing, weighing not less than 20 oz. per lineal yard. Color shall be selected from manufacturer's standard color selectors.
9. Exposed metal trim and seal color shall be manufacturers standard trim selector:
10. Aluminum track shall be clear anodized.
11. Core: Minimum 18 gauge steel frame top, bottom, jambs, and intermediates, welded construction, with acoustic insulation fill and gypsum board face sheets.
12. Hinges: Full leaf butt hinges, attached directly to panel steel frames.

B. Track: Extruded aluminum track, clear anodized architectural grade 6063-T6, or steel with overhead supports of adjustable steel hanger rods designed for size and type of operable panel partition assembly indicated. Track deflection shall be no more than 0.10 inch between bracket supports; thickness and profile designed to support live and dead loads.

C. Carriers: Ball bearing steel carrier assembly; one carrier per panel with all-steel bearings.

D. Accessories: Ceiling trim; aluminum jamb moldings with integral resilient acoustic seal, fittings, and attachments.

E. Hardware: Manufacturer's standard, finished to match exposed hardware on partition.

F. Provide the following items in quantities and locations as indicated on Drawings.

1. Pocket Door: Full height pocket doors at end of partition runs where indicated on Drawings to conceal "stacked" partition. Construct of same basic design, materials, thickness and acoustical qualities as panels. Provide standard-bearing butt hinges in finish to match other exposed hardware. Provide acoustical seals at soffit, floor and jambs.

a. Provide key-operated rim lock to secure pocket door in closed position.

2.03 ACCESSORIES

A. Pass Doors: Swinging door built into and matching panel materials, construction, acoustical qualities, fire rating, finish and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.

1. Pass-Door Hardware: Equip pass door with the following:

a. Door Seals: Mechanically operated floor seal on panels containing pass doors.
b. Panic hardware.
c. Concealed door closer.
d. Door Viewer: Installed with view in direction of swing.
e. Latchset: Passage set.
f. See Section 08 71 00 – Door Hardware for lock cylinder and keying requirements.

B. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.

1. Manufacturer's standard method to secure storage pocket door in closed position.
2. Rim Lock: Key-operated lock cylinder, keyed to master key system, to secure storage pocket door in closed position. Include two keys per lock.

2.04 OPERATION

A. Panels shall be manually moved from the storage area, positioned in the opening, and seals set.

B. Retractable Horizontal Seals:

1. Retractable horizontal seals shall be activated by a removable quick-set operating handle located approximately 42" from the floor in the panel edge.
2. Top and bottom retractable seals shall be operated simultaneously.

3. Seal activation requires approximately a 190 degree turn of the removable handle.

C. Final partition closure to be by lever closure panel with expanding jamb which compensates for minor wall irregularities and provides a minimum of 250 lbs. seal force against the adjacent wall for optimum sound control. The jamb activator shall be located approximately 45” from the floor in the panel face and be accessed from either side of the panel. The jamb is equipped with a mechanical rack and pinion gear drive mechanism and shall extend 4”-6” by turning the removable operating handle.

D. Stack/Store Panels: Retract seals with removable operating handle and move to storage area.

2.05 ACOUSTICAL PERFORMANCE

A. Acoustical performance shall be tested at a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with the following:

1. E90 Test Standards. Standard panel construction shall have obtained an STC rating of 52.

2.06 FINISHES

A. Fabric: Manufacturer’s standard mildew-resistant vinyl, complying with CFFA-W-101-A for Type II material.

B. Color: Interior Finish Legend on the drawings.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine flooring, floor levelness, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

B. Verify that field conditions are acceptable and are ready to receive work.

C. Confirm track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel to the floor surface.

D. Beginning of installation means installer accepts existing conditions.

3.02 INSTALLATION

A. Installation. The complete installation of the operable wall system shall be by an authorized factory-trained installer and be in strict accordance with the approved shop drawings and manufacturer’s standard printed specifications, instructions, andrecommendations.

B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

C. Install panels in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

3.03 TRAINING

A. Installer shall demonstrate proper operation and maintenance procedures to owner’s representative.

B. Operating handle and owner’s manuals shall be provided to owner’s representative.

3.04 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to drawn position.

B. Visually inspect partition in drawn position for light leaks to identify a potential acoustic leak. Adjust to achieve light seal.

C. Clean finish surfaces and partition accessories.

END OF SECTION

SECTION 10 26 13

CORNER GUARDS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes flush mount corner guard for wall protection including.

1. Stainless steel corner guards
2. Installation accessories

1.02 ACTION SUBMITTALS

A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in unopened factory packaging to the jobsite and store in original packaging in a climate controlled location away from direct sunlight.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with impact-resistant wall-protection units by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.02 CORNER GUARDS

A. Stainless Steel Flush Mount Corners Guards:

1. Basis-of-Design Manufacturers: Construction Specialties Inc., 8PH Series or comparable product of one of the following:

    a. ProTek Systems, Inc., CG-200
    b. Inpro Corp., SSCG-FM

2. Material: Stainless steel, Type 304.

    a. Thickness: 16 gauge
    b. Wing Size: 2 inches
    c. Height: One piece, full height of wall
    d. Profile: 90 degrees with 3/16 inch radius nose
    e. Reveal: As specified on drawings. 5/8-inch typical for gypsum board applications
    f. Finish: Directional satin, No. 4 satin finish

3. Attachment: Mechanical fastening with mounting flush to gypsum board.

a. Include mounting hardware.

2.03 FABRICATION

A. Fabricate impact-resistant wall-protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

B. Fabricate components with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections.

2.04 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Remove tool and die marks and stretch lines or blend into finish.

C. Grind and polish surfaces to produce uniform, polished finish indicated, free of cross scratches.

1. Run grain of directionally textured finishes with long dimension of each piece.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.03 INSTALLATION

A. General: Locate the corner guard as indicated on the approved detail drawing for the appropriate substrate and in compliance with manufacturers installation instructions. Install corner guard level and plumb full height of wall, do not splice.

B. Installation of Stainless Steel Corner Guard:

1. Surface must be dry, clean and properly sealed.
2. Screw on: Position the corner guard on the wall and attach it using the supplied screws.
3. Remove the protective plastic covering from the exposed surface of the corner guard.

3.04 CLEANING

A. Immediately after completion of installation, clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

END OF SECTION

SECTION 10 28 13

TOILET ACCESSORIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes toilet and bath accessories.

1. Furnish toilet and bath accessory templates, to locate anchorage reinforcement, to trades responsible.

B. Related Sections:

1. Section 06 10 00 – Rough Carpentry: Wood blocking for support of toilet and bath accessory items.
2. Section 09 29 00 – Gypsum Board: For required wood or metal supports within metal stud wall system.
3. Section 09 30 13 – Ceramic Tiling.
4. Refer to Drawings for toilet accessory schedule and accessory mounting heights.

1.02 REFERENCES

A. ADAAG: Americans with Disabilities Act Accessibility Guidelines.

B. ANSI A117.1 – Specifications for Making Buildings and Facilities Accessible To and Usable by Physically Handicapped People.

C. Ohio Building Code – Chapter 11 – Accessibility.

1.03 SYSTEM DESCRIPTION

A. Toilet accessories shall be provided to conform with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local Regulations. These requirements supersede Technical Specifications in this Section.

1. Product data on accessories indicating quality, describing size, finish, details of function, attachment methods.
2. Schedule indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.
3. Setting drawings, templates, instructions, and directions for installation of anchorage devices and cut-out requirements in other work.
4. Maintenance instructions including replaceable parts and service recommendations.

1.04 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings:

1. Plans: Locate each specified unit in project.
2. Elevations: Indicate mounting height of each product.
3. Details: Indicate anchoring and fastening details, required locations and types of anchors and reinforcement, and materials required for installation of specified products.

C. Verification Samples: One sample chips of each specified color and finish.

1.05 INFORMATIONAL SUBMITTALS

A. Literature: Manufacturer's product data sheets, for each item furnished hereunder.

B. Schedule: Complete schedule, indicating types, quantity, and model numbers of accessories for each location in which the accessories will be installed.

C. Selection samples: Sample color chips indicating each manufacturer's full range of colors available for selection by Architect.

D. Verification samples: Complete units, as requested by Architect.

E. Manufacturer's Warranty:

1. Deliver to the Owner upon completion of the work of this Section, applicable manufacturer's standard warranties.

F. Closeout Submittals: Warranty, issued and executed by manufacturer, and countersigned by Contractor.

1. One set of special adjusting or installation tools unique to the products furnished under this section.
2. Keys to accessories furnished under this section.

1.06 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 3, provide products of same manufacturer unless otherwise scheduled or approved by Architect.

B. Furnish accessory manufacturer's inserts and anchoring devices for use in masonry or concrete; coordinate delivery with other work to avoid delay.

C. Design, fabricate, and install handicapped toilet compartment grab bars capable of withstanding a downward dead load of at least 250 lb. per foot without damage or permanent set to grab bar members or anchors.

D. Exercise care to prevent damage to existing surfaces or equipment. At time of completion, accessories shall be in perfect condition, well anchored, and in proper alignment at the location indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Deliver accessories in manufacturer's original containers and store in same until installation.

B. Keys: Furnish 2 keys for each accessory item required to have a lock. Seal in clearly marked envelopes and turn over to Owner prior to building acceptance.

1.08 PROJECT CONDITIONS

A. Coordinate accessory locations, installation, and sequencing with other work to avoid interference and to assure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

1.09 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Coordinate locations, dimensions, and other pertinent details with installation of backing, blocking, and electrical connections.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Toilet accessories shall be manufactured by Bobrick Washroom Equipment, Inc., Clifton Park, NY; specified as the type, size and function as described in the Toilet Accessory Schedule.

B. Products of the following manufacturers will be considered, providing their products equal or exceed the quality specified; and they can provide products of the type, size, function, and arrangement required:

1. Bradley Corporation, Menomonee Falls, WI
2. American Specialties Inc., Yonkers, NY

2.02 MATERIALS: TOILET ACCESSORIES

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19 flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch (0.9-mm) minimum nominal thickness.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

1. Provide tempered glass, where indicated.

H. Galvanized Steel Mounting Devices: ASTM A153, hot dip galvanized after fabrication.

I. Fasteners and Anchors: Non-corrosive, theft-resistant, screws, bolts and other fastening devices of same material as accessory unit or of galvanized steel where concealed.

1. Provide mounting kits with stainless steel screws for accessories requiring same.
2. Mounting kits shall include toggle nuts for hollow walls and expansion shields for solid walls. Provide 2 fasteners at each mounting plate.
3. Provide 12 gauge, 3 inches wide, steel concealed anchor plates with tapped holes for installation of grab bars on walls constructed with metal studs.
4. Provide concealed anchors for installation of grab bars on solid walls. Anchor assembly shall consist of tapped 12 gauge anchor plate, 10 gauge back plate, and 3/8 inch diameter thru-wall bolt.

J. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing and resupply.

2.03 INSTALLATION OF ACCESSORIES

A. Fasteners, screws, and bolts: Type 304 stainless, tamperproof.

B. Expansion shields: Fiber, lead or rubber as recommended by accessory manufacturer for component and substrate.

2.04 FABRICATION

A. Recessed and modified surface mounted dispensing and disposal cabinets shall be constructed as follows:

1. Exposed surfaces shall be of 22 gauge type 304 stainless steel with concealed stainless steel piano hinge on doors.
2. There shall be 1/4 inch return on face trim.
3. Each cabinet shall be provided with pin tumbler type locks (to match existing if possible) and two keys with the exception of the napkin vendors, which shall have door locks and coin box locks, keyed differently.
4. Cabinets shall have a common fascia with grain on exposed surfaces, lapped in one direction to a #4 satin finish.
5. Dispensers shall be equipped with sight or mechanical gauge for easier refill.
6. Disposals shall be completely enclosed and removable plastic; waste receptacles shall be constructed of heavy duty polyvinyl.

B. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent moisture accumulation, as follows:

1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

C. Mirror Unit Hangers: Provide system for mounting mirror units that will permit rigid, tamperproof, and theft-proof installation, as follows:

1. One piece, galvanized steel, wall hanger device with spring action locking mechanism to hold mirror unit in position with no exposed screws or bolts.

D. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide minimum of 6 keys to Owner's representative.

2.05 FACTORY FINISHING

A. Ferrous metals: Clean and treat, spray apply one coat of baked-on rust and moisture-resistant primer, followed by two coats of baked-on synthetic enamel, in selected colors. Ensure that finish coating is uniform in color intensity and degree of gloss, throughout.

B. Chrome/Nickel Plating: ASTM 456, Type SC2, satin finish.

C. Stainless steel: Number 4 satin finish, except as otherwise specified above under the Article entitled “Toilet Accessories”.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that site conditions are ready to receive work and dimensions are as indicated on shop drawings.

B. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site at appropriate time for building-in.

B. Provide templates and rough-in measurements as required.

C. Verify exact location of accessories for installation.

3.03 INSTALLATION

A. Install accessories in accurate locations as noted on drawings; securely anchored to substrate surfaces.

B. Install items in accordance with manufacturer's recommendation.

1. Wall mounted items to be secured with devices suitable for the wall construction. Lead, plastic, wood, or fiber plugs are not acceptable.
2. Accessories not located on drawings shall be installed where directed by the Architect.
3. Provide theft resistant type exposed fasteners.

C. Install accessories plumb, level, straight, and properly aligned with adjacent surfaces.

1. Install accessory units to accommodate the physically handicapped, with operating areas of coin slots, openings for dispensers and waste not more than 40 inches above the floor.
2. Mount grab bars at not greater than 36 inches above the floor, and anchor to comply with specified performance requirements. Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.
3. Comply with ANSI A117.1 accessibility requirements.

D. Accessories shall have concealed mounting and fastening devices for types of partitions as follows:

1. Concrete masonry units: Integral anchors.
2. Gypsum board and metal stud partitions: Screws or bolts secured to metal plates anchored to studs.

E. Coordinate installation of accessories in toilet compartments and work of other trades to allow proper operation. Notify the Architect in case of conflict.

3.04 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish all exposed surfaces in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION

SECTION 10 43 13

DEFIBRILATOR AND CABINET

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes automatic external defibrillator and cabinet.

1.02 ACTION SUBMITTALS

A. Product Data: For each product indicated.

1. Cabinet: Include dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Maintenance Data: For defibrillator cabinet to include in maintenance manuals.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products according to manufacturer's written instructions.

1.04 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions.

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 7 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 AUTOMATIC EXTERNAL DEFBRILLATOR

A. Products: Subject to compliance with requirements, provide Cardiac Science; Powerheart AED G5 Fully Automatic and AED cabinet with alarm.

1. Automatic external defibrillators shall enable communications via a serial port or USB (via adaptor) for PCs with Windows. Device stores and offers download of data after an event so the hospital, physician, or emergency medical technician (EMT) can review what happened during the rescue (using Rescuelink software).

B. Cabinet door shall be alarmed and tied into Owner‘s access control system.

C. Cabinet Dimensions: 17-1/2 inch H x 17-1/2 inch W x 7 inch D

D. Cabinet key cylinder shall be cored to Owner‘s existing core system.

E. Source Limitations: Obtain defribrilator and cabinet through one source from a single manufacturer.

2.02 ACCESSORIES

A. AED Sign: Manufacturer's standard sign.

B. Fasteners: Use types and sizes recommended by manufacturer to suit unit installation conditions.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install defibrillator cabinet securely, square and plumb at locations and mounting heights indicated on Drawings, and according to manufacturer's written instructions.

B. Install cabinet surface mounted on walls. Cabinet shall be mounted per requirements of authorities having jurisdiction, the ADA, and building code.

C. Mount AED Sign above cabinet.

3.03 CLEANING AND ADJUSTING

A. Clean defibrillator cabinet according to manufacturer's written instructions.

B. Remove temporary protective coverings and strippable films, if any, as defibrillator cabinet are installed unless otherwise indicated in manufacturer's written installation instructions.

C. Restore defibrillator cabinet damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged defibrillator cabinet and replace with new units.

3.04 PROTECTION

A. Protect defibrillator cabinet according to manufacturer's written instructions.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes portable fire extinguishers and fire-protection cabinets.

B. Related Section:

1. Section 04 22 00 – Concrete Unit Masonry
2. Section 09 29 00 – Gypsum Board

1.02 REFERENCES

A. NFPA 10 - Portable Fire Extinguishers

B. ADA Accessibility Guidelines

C. UBC Standard 7-5 (ASTM E-814-83) - Fire-rated cabinet option for combustible and non-combustible walls.

1.03 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures:

B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

1. Fire Extinguishers: Include rating and classification.
2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain extinguishers through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, “Standard for Portable Fire Extinguishers.”

C. Each extinguisher shall be listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

D. Equipment shall conform to all applicable codes and regulations in effect at the project location.

1.05 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit manufacturer's operation and maintenance data including test, refill or recharge schedules, procedures, and re-certification requirements.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Fire-Protection Cabinets:

a. Larsen's Manufacturing Company

b. J.L. Industries, Inc.
c. Potter-Roemer; Div. of Smith Industries, Inc.

2. Portable Fire Extinguishers:

a. Amerex Corporation.
b. Ansul Incorporated.
c. Badger; Div. of Figgie Fire Protection Systems.
d. J.L. Industries, Inc.
e. Kidde: Walter Kidde, The Fire Extinguisher Co.
f. Larsen's Manufacturing Company.
g. Potter-Roemer; Div. of Smith Industries, Inc.

2.02 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

1. Sheet: ASTM B 209.
2. Extruded Shapes: ASTM B 221.

2.03 FIRE PROTECTION CABINETS

A. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.

1. Basis of Design

a. Larsen’s Architectural Series, Model 2712-R (recessed).
b. Larsen’s Architectural Series, Model 2712-RL (semi-recessed).

B. Cabinet Size:

1. Suitable for fire extinguisher specified but minimum 27 inches H, 12 inches W, and 8 inches D.

C. Cabinet Mounting: Suitable for the following:

1. Recessed: Cabinet box completely recessed in walls of depth to suit installation.
2. Semi-Recessed: Cabinet box recessed in walls of depth to suit style of trim indicated.
3. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.

D. Cabinet Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

1. Trim Material: Steel.

E. Door Style and Material: Manufacturer's standard, as follows:

1. Door Material: Enameled Steel
2. Door Style: Small view window with frame
3. Door Glazing: Acrylic

a. Acrylic Sheet Color: Clear

4. Door Construction: Provide a minimum ½-inch thick door frames.

F. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed door pull handle and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

1. Door hardware shall comply with ADA requirements for wall projection.

G. Cabinet and Door Finishes: Provide manufacturer’s standard baked-enamel paint for the exterior and interior of the cabinet and doors.

2.04 FIRE EXTINGUISHERS

A. Basis of Design: Multi-Purpose Dry Chemical Type UL rated 4-A:80-B:C; 10 pounds nominal capacity; in red enameled steel container; for Class A, Class B, and Class C fires.

B. Provide one fully charged fire extinguisher for each fire extinguisher cabinet.

C. Safety Release Handle: Design to prevent accidental discharge

D. Meter: Design to indicate level of charge.

E. Metal Plate: Embossed with description of performance, indicating code and UL conformance.

F. Furnish manufacturer's standard surface brackets for the surface mounted extinguishers.

G. Fire extinguishers shall be furnished complete with charge services and ready for operation.

2.05 ACCESSORIES

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

a. Location: Applied to cabinet door

1) Larsen's "Type A".

b. Application Process: Silk-screened
c. Lettering: Black, 2-inch lettering
d. Orientation: Vertical

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed. Verify that rough openings for cabinets are correctly sized and located.

B. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

3.02 PREPARATION

A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION OF FIRE EXTINGUISHER CABINETS

A. Comply with manufacturer's written instructions for installing fire extinguisher cabinets.

B. Install fire extinguisher cabinets at locations specified on the drawings.

C. Mounting Height: Install fire extinguisher cabinets at the height required so that the top of the fire extinguisher is not more than 54 inches above the floor.

D. Fire extinguisher cabinets shall protrude no more than 4 inches into corridors, passageways, or aisles.

E. Repair/paint wall surfaces surrounding fire extinguisher cabinet damaged during installation to match existing wall surface.

3.04 INSTALLATION OF FIRE EXTINGUISHERS

A. Install portable fire extinguishers on the hanger or in the bracket supplied. Verify that the extinguisher operating instructions face outward.

B. Comply with manufacturer's written instructions for installing fire extinguishers and mounting brackets.

C. Mounting Height: Install portable extinguishers at height indicated below.

1. Install fire extinguishers mounted on hangers or brackets attached to a wall so that the top of the fire extinguisher is not more than 3½ ft. above the floor.

3.05 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust cabinet doors to swing and operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 10 51 13

METAL LOCKERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes metal wardrobe lockers, including but not limited to the following:

1. Standard metal double-tier lockers.
2. Hooks, latches, and hardware.
3. Attachment hardware.

B. Related Sections:

1. Section 06 10 53 – Miscellaneous Rough Carpentry.

1.02 REFERENCES

A. ASTM A 1008 – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

1.03 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for metal locker units. Including materials, accessories, construction, finishes and assembly.

B. Shop Drawings: Submit shop drawings for metal lockers, verifying dimensions affecting locker installations. Indicate relationship to adjoining surfaces Show locker elevations and details, method of installation, fillers, trim, base, and accessories. Include locker numbering sequence information. Indicate installation and anchorage requirements.

C. Samples: Submit color samples on squares of same metal to be used for fabrication of lockers.

1.04 QUALITY ASSURANCE

A. Components of lockers shall be sourced from one single source manufacturer who certifies that materials meet or exceed specifications.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the project site in the manufacturer’s original containers with labels indicating brand names, colors and quality designations, legible and intact.

B. Store and protect accepted materials in accordance with the manufacturer’s direction and recommendations.

C. Handling: Protect materials and finish during handling and installation to prevent damage.

1.06 PROJECT CONDITIONS

A. Do not deliver metal lockers until building is enclosed and ready for locker installation.

B. Delivery: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with clearly identifying product name and manufacturer.

C. Storage: Store materials in clean, dry area indoors in accordance with manufacturer’s instructions.

D. Handling: Protect materials and finish during handling and installation to prevent damage.

1.07 EXTRA STOCK MATERIALS

A. Furnish extra material described below, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Locks: Furnish quantity of locks equal to 5 percent of number installed.

B. Package material separately, distinctly marked, and adequately protected against deterioration.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Metal Locker Manufacturer:

1. Basis of Design: Lyon Workspace Products of Aurora, IL; Standard steel lockers.

B. Acceptable Products:

1. Subject to compliance with requirements, provide the “Basis of Design” product or a product of the following:

a. Republic Storage Products, Inc. Standard lockers, Canton, OH.
b. Penco Products, Inc., Subsidiary of Vesper Corporation; Guardian Lockers, Oaks, PA.
c. Hadrian Inc.; Emperor Lockers, Mentor, OH.
d. List Industries Inc.; Marquis Protector Single-Point Latch Corridor Lockers, Deerfield Beach, FL.
e. DeBourgh Mfg. Co.; Sentry Corridor/ Personal Lockers, La Junta, CO.

2. Products of these manufacturers shall meet or exceed specification requirements for the “Basis of Design” product. Pattern and color will be selected by the Architect.

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS) Type B, suitable for exposed applications.

B. Fasteners: Cadmium, zinc, or nickel plated steel; exposed bolt heads, slotless type; self-locking nuts or locker washers for nuts or moving parts.

C. Equipment:

1. Number plates: Etched black figures on aluminum plate, 2-3/4-inches wide by 1-inch high. Locker number 1 shall be the upper left unit and numbering shall run consecutively from left to right. Locker number 5 shall be below number 1 and so on.
2. Lock hasp: Hasp integral to the handle, to accept Owner’s padlocks.

2.03 FABRICATION, GENERAL

A. Construction: Fabricate lockers square, rigid, and without warp, with metal faces flat and free from dents or distortion. Make all exposed metal edges safe to touch. Weld frame members together to form rigid, one-piece structure. Weld, bolt, or rivet other joints and connections as standard with manufacturer except as noted. Grind exposed welds flush. Do not expose bolts or rivet heads on fronts of locker doors or frame.

B. Frames: Fabricate of 16 gauge channels or 12 gauge angles, minimum, with continuous stop/strike formed on vertical members.

C. Finishing: Chemically pretreat metal with degreasing and phosphatizing process. Apply baked-on enamel finish to all surfaces, exposed and concealed, except plated and non-ferrous metal.

1. Provide manufacturer’s standard color finish on locker units as selected by Architect. Unless otherwise indicated, concealed parts may be manufacturer's standard neutral color.

2.04 LOCKERS

A. Standard: Double-tier, each at 12 inches wide, 15 inches deep, for overall height of 36 inches high with closed base, flat top.

B. Body: Fabricate backs and sides with double flange connections extending full height. Form top and bottom with flanged edges.

1. Tops: 16-gauge minimum with flat tops.
2. Bottoms: 16-gauge minimum.

3. Backs: 24-gauge minimum.
4. Sides: 24-gauge minimum.

C. Doors and Frames: One-piece, minimum 16-gauge sheet steel, flanged at all edges, constructed to prevent springing when opening or closing. Fabricate to swing 180 degrees.

D. Hinges: Heavy-duty, not less than 0.050 inch thick steel, full-loop, 5-knuckle, tight pin, 2 inches high. Weld to inside of frame and secure to door with not less than 2 factory-installed fasteners which are completely concealed and tamperproof when door is closed.

1. Provide a least 2 hinges for each door under 42 inches high.

E. Lock: Padlock hasp and stainless steel strike plate with an integral handle pull.

F. Latching: Once-piece pre-lubricated spring steel latch with two (2) latching points on lockers 42 inches high or less.

2.05 LOCKER ACCESSORIES

A. Number Plates: Manufacturer's standard etched, embossed, or stamped, non-ferrous metal number plates with numerals not less than 1/2 inch high. Number lockers in sequence as directed by Architect. Attach plates to each locker door, near top, centered, with at least 2 fasteners of same finish as number plate.

B. Separators: Provide horizontal dividers of not less than 16 gauge sheet steel between doors of multiple-tier lockers, to ensure rigidity.

C. Filler Panels: Provide filler panels where indicated, of not less than 18 gauge steel sheet, factory-fabricated and finished to match locker units.

D. End Panels: Provide solid special end upright panels on lockers with exposed sides. Exposed end panels shall be 16 gauge and shall have no extra holes.

E. Bottoms: Painted galvannealed steel, 16 gauge.

F. Bases: Closed style, fit in 6-inch high spaces between legs, for 6-inch leg lockers.

G. Hooks: Zinc-plated forged steel, ball ends.

H. Provide metal base reinforcement with fire-treated wood securely bolted.

2.06 FINISH

A. Standard Finish: Exposed steel parts shall be thoroughly cleaned, given bonding and rust-inhibitive phosphate treatment, and electrostatically sprayed with heavy coat of enamel. Baked-on finish. Factory apply finish in accordance with manufacturer’s instructions.

B. Color: As selected form manufacturers full range of colors.

PART 3 – EXECUTION

3.01 PREPARATION

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication of special components, when possible, to ensure proper fitting of work. However, allow for adjustment and fitting of trim and filler panels wherever taking of field measurements before fabrication that might delay work.

3.02 INSTALLATION

A. Install metal lockers at locations shown in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation.

B. Anchor lockers to base and walls at intervals recommended by the manufacturer but no greater than 36 inches. Install anchors through back-up reinforcing plates where necessary to avoid metal distortion; conceal fasteners insofar as possible.

C. Install trim, metal base, and metal filler panels where indicated, using concealed fasteners to provide flush, hairline joints against adjacent surfaces.

1. Metal Fillers: Install metal fillers using concealed fasteners.
2. Joints: Provide flush hairline joints against adjacent surfaces.

D. Number Plates: Attach number plates to face of doors with 2 aluminum rivets. Attach in sequence, beginning with “01” at upper left and moving down to “03” at the lower left, then “04” adjacent to “01”, and “05” adjacent to “02”, and so on through “30” at the lower right.

E. Provide manufacturer’s supplied hardware.

F. Repair minor damages to finish in accordance with manufacturer’s instructions and as approved by Architect.

G. Remove and replace defective or damaged components that cannot be successfully repainted as determined by Architect.

H. Sloping Hoods and Metal Fillers: Install sloping hoods and metal fillers using concealed fasteners.

3.03 ADJUST AND CLEAN

A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.

B. Clean surfaces promptly after installation in accordance with manufacturer’s instructions.

C. Do not use harsh cleaning materials or methods that could damage finish.

D. Touch-up marred finished, but replace units which cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

E. Protect installed lockers from damage during construction.

END OF SECTION

SECTION 11 24 29

FACILITY FALL PROTECTION

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes the performance requirements for the design, supply, and installation of a complete Engineered Fall Protection (Horizontal Lifeline) System, including related accessories, as follows:

1. Design of the fall protection system, including complete shop drawings.
2. Development of attachment loadings for review by the Architect.
3. Furnish all fall protection components, wire rope, attachment devices and supplementary structural supports.
4. Testing and certification of the finished systems.
5. Development of printed documentation (User's Manual) for the use, care and maintenance of the fall protection system.
6. Training in the use, care and maintenance of the fall protection system.

B. General Requirements: Fall protection coverage shall be as shown on the drawings and as referenced herein.

1.02 REFERENCES

A. ASTM International:

1. ASTM A53 – Standard Specification for Pipe, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A123 – Standard Specification for Zinc Coating (Hot-Dipped) Galvanizing on Iron and Steel Products.
3. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes.
4. ASTM B209 – Standard Specifications for Aluminum and Aluminum Alloy Sheet and Plate.
5. ASTM A666 – Standard specification for Annealed or Cold Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar."

B. AWS D1.1 Structural Welding Code Steel.

C. ANSI Z359.1 – Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components.

1.03 SYSTEM DESCRIPTION

A. Design Responsibility: An approximate number of roof anchors on individual sections of roofs are shown on the design drawings. Roof anchor manufacturer shall be responsible for determining optimum anchor layout and quantity of anchors as required to meet OSHA requirements for attachment. Engage a registered Engineer to design all components and all attachments to the building structure to meet the structural performance requirements, below.

B. Roof Anchors Layout: The extent of the Fall Protection System (FPS) is shown on the drawings. It shall, in general, allow the users to walk uninterrupted over entire roof surface areas to the length of the line and provide a secure anchorage to arrest an accidental fall. Layout shall permit free movement of persons while attached by full body harness, retractable life line, and vertical life line attached to roof anchor at each anchor location using quick release attachments.

C. Structural Performance: Provide anchors that have been designed, fabricated and installed to withstand the following loads as demonstrated by calculations prepared by the manufacturer's design engineer.

1. Roof anchor Assemblies: Design anchors and connections to resist 5,000 pounds load pullout force without damage to underlying roof structure, without detachment or fracture of anchor assembly.

    a. Provide supplementary plates, attachments and anchors as required to transfer loads to structural frame.

2. Arrest Force on Anchors: Design to maximum of 1,800 pounds or less.

3. Lifeline system to be design to support two (2) persons falling from the same location.
4. Free Fall Distance: Design for purposes for roof maintenance to limit free fall to six (6) feet.
5. End and intermediate anchors to resist at least two times the calculated design load without detachment or fracture occurring.

1.04 SUBMITTALS

A. General: Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Include complete layout and configuration of the engineered fall protection system, including.

1. All components and accessories.
2. Roof Plan: Show locations of all roof anchor and davit positions.
    a. Roof anchor assemblies: Show sizes, height, thicknesses, and type and grade or strength of materials; show type and size of welds.
    b. Clearly indicate design and fabrication details, anchorage details, hardware, and installation details.
3. Include all reactions, forces and connection details to the existing structure.
4. Include all usage instructions and general requirements on the drawings.

C. Operation and Maintenance Manual: Submit copies of finished O&M Manual when installation, testing and certification are complete. Indicate parts list with serial numbers for all critical parts. Include instructions on safe operation and on all required inspections and maintenance activities. Include place to document all future inspections and repairs.

1.05 QUALITY ASSURANCE

A. Single Source Manufacturer Responsibility: Provide all roof anchor and davit components from a single manufacturer whose products meet or exceed structural performance requirements, complete with design and engineering capability to perform intended work.

B. Installer Qualifications: Roof anchor manufacturer or an installer licensed and approved by roof anchors.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of roof anchors that are similar to those indicated for this Project in material, design and extent.

1. Provide shop drawings sealed by a registered professional engineer.
2. Design engineered Fall Protection System to in accordance with plans, specifications, standards, regulations and codes as required by this section.
3. Design all anchor components including supplemental anchorage steel to building structure to provide adequate attachment for imposed loads. Design shall be in accordance with current engineering.

D. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.

E. Contractor’s Quality Control Responsibilities: Contractor is solely responsible for quality control of the Work.

1.06 PREINSTALLATION CONFERENCE

A. Schedule a job conference to review the work the work of this section, prior to scheduled commencement of work on the actual building. Conference shall be attended by roof anchor manufacturer, or his full time site representative, installer; trades installing building framing or structural concrete, Architect, Owner, and other representatives directly concerned with structural and waterproofing performance of the Work. The following major considerations shall be reviewed at conference:

1. Review roof anchor and davit layout and installation methods.
2. Review sequencing and coordination requirements with related trades.
3. Review code compliance procedures.

4. Review field quality control procedures for roof anchor manufacturer's acceptance.

1.07 DELIVERY STORAGE AND HANDLING

A. Deliver all equipment and components in strict accordance with the project schedule and at such time as when construction and finish of adjoining work will permit and in sufficient time to avoid delays to the construction process.

B. All equipment unloading at the job site and/or storage shall be the responsibility of the Contractor.

C. The Contractor shall furnish all anchors and items to be embedded with detailed instruction to the main Contractor for installation.

1.08 PROJECT/SITE CONDITIONS

A. Examine surfaces and areas upon which the work of this Section depends. Report in writing any defects of work prepared by other trades and any other unsatisfactory site conditions which would cause defective installation of products, or cause latent defects in workmanship and function.

B. Verify site dimensions.

C. Commencement of work will imply acceptance of prepared work.

1.09 WARRANTY

A. Provide manufacturer's standard warranty to guarantee products will be free from defects for a period of 12 months. Warranty period shall become effective on date of substantial completion.

1.10 MAINTENANCE

A. Contractor shall provide for the maintenance of the fall protection system, including inspections, and written reports for a period of five years following the date of Substantial Completion at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Fall protection systems manufactured by XSPlatforms, Chico, CA, and distributed by Guardian Fall Protection Inc., Kent WA. or equivalnt horizontal lifeline systems of one of the following.

1. Capital Safety Group USA, Red Wing, MN
2. Rooftop Anchor, Inc., Heber City, UT

B. Substitution approved by Architect in accordance with Section 01 25 00 – Substitution Procedures.

2.02 SYSTEM COMPONENTS

A. Roof Anchors: Guardian Fall Protection: Roof Mounted: XS Horizontal Lifeline System with CB posts and XS Horizontal lifeline cable system for direct attachment to structural frame. Baseline quantity of anchors per Drawings:

B. Horizontal Lifeline Components:

1. Anchor post: XTS-Impact anchors, each assembly consisting of aluminum XTS-Base plate, type 304 or 316 stainless steel XTS-Bending shaft, aluminum XTS-Bending tube, and rubber O-ring.
2. Anchors: XTS-Toggle Anchor or XTS-Mechanical Anchor for attachment to structural deck, type 304 or type 316 stainless steel.
3. XTS Linked Lifeline components: Aluminum and Type 304 or 316 stainless steel.
    a. Tensioner Set: Tensioning unit with turnbuckle and tension indicator.
    b. Intermediate supports: Intermediate straight and elbow units to attach to roof anchors.
    c. Terminations: Swaged terminations to attach cable to end anchors.
    d. In-line Shock Absorbers: As determined by manufacturer to reduce loads exerted on anchor points.

4. Lifeline Cable: 5/16 inch diameter type 316 stainless steel wire rope as tested by fall protection device manufacturer.
5. Cable Shuttles: Detachable cable shuttle providing secure attachment to cable at any location. Type 304 or 316 stainless steel.
6. Fasteners: Provide stainless steel fasteners or zinc-plated fasteners with coating complying with ASTM B 633 F 1941, Class Fe/ZN 5, or equivalent. Fasteners to be selected for type, grade, and class required.

2.03 FABRICATION

A. Fabricate work true to dimension, square, plumb, level and free from distortion or defects detrimental to appearance and performance.

B. Grind off surplus welding material and ensure exposed internal corners have smooth lines.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verification of Conditions**:** Examine the areas to receive the Work and the conditions under which the Work would be performed. Remedy conditions detrimental to the proper and timely completion of the Work.

B. Examine structural framing and substrate and verify conditions comply with structural requirements for proper system performance. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install all system components in accordance with approved shop drawings and manufacturer's recommendations.

B. All attachments are to be permanent, utilizing welded, clamped or bolted construction.

C. Separate dissimilar metals with suitable coating or membranes to prevent electrolysis.

D. Fall protection Contractor to utilize temporary fall protection means and methods during installation to ensure 100% tie-off for installation crew.

E. Coordinate installation with work of all other related trades.

F. Install all work true, level, tightly fitted and flush with adjacent surfaces as required.

G. Deform threads of tail end of anchor studs after nuts have been tightened to prevent loosening by vibration, accidental removal or vandalism.

3.03 SOURCE, QUALITY CONTROL

A. Completed horizontal lifeline system shall be load tested in accordance with system manufacturer's requirements:

B. Do not use, load or stress the fall protection system until all components, materials and fasteners are properly installed, tested and ready for service.

C. Final Adjustment and Inspection:

1. Adjust, inspect and leave completed system in proper working order.
2. Complete "Certification for Use" form and include with O&M Manual.

3.04 TRAINING

A. Training program is to include sections on all aspects of the fall protection system, including use, care and maintenance.

B. Include training on recommended rescue procedures should a fall occur.

C. Hold one class, to be scheduled at the end of installation.

END OF SECTION

SECTION 11 31 00

APPLIANCES

PART 1 – GENERAL

1.01 SUMMARY

A. Provide appliances as shown and specified. Provide labor, materials and equipment necessary to complete the work of this section, including but not limited to the following items:

1. Refrigerator/ Freezer with icemaker

B. Related Sections:

1. Division 22 - PLUMBING for water distribution piping connections, drainage and vent piping connections, sinks, and waste disposers.
2. Division 26 - ELECTRICAL for services and connections to appliances.

1.02 ACTION SUBMITTALS

A. Prepare submittals in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.

1.03 INFORMATIONAL SUBMITTALS

A. Maintenance Data: Submit maintenance data and parts lists to Owner.

B. Operator's Manuals: Submit required sets of dimensional prints, data sheets, manuals and instructions for properly operating equipment. Instructions for operating equipment, together with written guarantee and warranty shall be bound in a booklet per requirements of Section 01 77 00 – Closeout Procedures, and submitted to the Architect.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintains, within 50 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

B. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

C. Certification Labels: Provide equipment which complies with standards and bears certification labels as follows:

1. Energy Ratings: Provide energy guide labels with energy cost analysis (annual operating costs) and efficiency information as required by Federal Trade Commission.
2. UL Labels: Where available, provide UL labels on prime electrical components of food service equipment. Provide UL "recognized marking" on other items with electrical components, signifying listing by UL, where available.
3. Sanitary Construction and NSF Standards: Comply with applicable National Sanitation Foundation (NSF) standards and recommended criteria. Provide each principal item of food service equipment with a NSF "Seal of Approval."

D. Source Limitations: Provide appliances all by one manufacturer.

E. Regulatory Requirements, Accessibility: Where appliances are indicated to comply with accessibility requirements, comply with local regulations and with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver equipment to the project site in factory-fabricated containers designed to protect equipment and finish until final installation.

B. Storage at Project Site: Store equipment in original containers in a location to provide adequate protection to equipment while not interfering with other construction operations.

C. Handling: Handle equipment carefully to avoid damage to components, enclosures, and finish. Do not remove covering until required to clean, test, calibrate and demonstrate the unit. Do not install damaged equipment; replace and return damaged components to equipment manufacturer.

1.06 COORDINATION

A. Refer to Division 22 and 26 sections for plumbing and electrical connections and power.

1.07 WARRANTY

A. Submit manufacturers standard written warranty for each type of equipment required.

B. Warranty materials and workmanship for a period of one year from the date of acceptance by the Owner. Should defects develop within the guarantee period, upon written notice of same, remedy the defects and reimburse the Owner for all damage to other work, whether caused by the defects or by the work of correcting the defects.

PART 2 – PRODUCTS

2.01 REFRIGERATOR/FREEZERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:

1. Whirlpool Corporation.
2. General Electric Company (GE).
3. Sears Brands LLC (Kenmore).

B. Refrigerator/Freezer:

1. Basis-of-Design Product: Whirlpool 21 Cubic Foot Top-Freezer Refrigerator; Model WRT511SZD.
2. Type: Freestanding.
3. Dimensions:
    a. Width: 32-3/4 inches.
    b. Depth: 34 inches.
    c. Height: 66-1/4 inches.
4. Storage Capacity:
    a. Refrigeration Compartment Volume: 15 cu. ft.
    b. Freezer Volume: 6 cu. ft.
5. Refrigerator Features:
    a. Interior light in refrigeration compartment.
    b. Compartment Storage: vegetable crisper and meat compartment.
    c. Door Storage: Modular compartments.
6. Freezer Features:
    a. Automatic defrost.
    b. Interior light in freezer compartment.
    c. Automatic icemaker and storage bin.
7. Appliance Color/Finish: Stainless steel.

2.02 FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, service-utility connections, and other conditions affecting installation and performance of food service equipment.

B. Examine roughing-in for piping, mechanical, and electrical systems to verify actual locations of connections before installation.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install equipment level and plumb, according to manufacturer's written instructions, original design, and referenced standards.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

C. Utilities: Refer to Divisions 22 and 26 for plumbing and electrical requirements.

3.03 ADJUST AND CLEAN

A. Testing: Test each item of equipment to verify proper operation. Make necessary adjustments.

B. Accessories; Verify that accessory items required have been furnished and installed.

C. Cleaning: Remove packing material from equipment items and leave units in clean condition, ready for operation.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train the Owner’s maintenance personnel to adjust, operate, and maintain appliances.

END OF SECTION

SECTION 11 52 16

PROJECTOR MOUNTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes ceiling mounted projection mounts, including mounting hardware and accessories.

B. Related Sections:

1. Division 26 Sections for electrical wiring, connections, and installation of remote-control switches for electrically operated projection screens.

1.02 ACTION SUBMITTALS

A. Provide the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of mount, including manufacturer recommended installation procedures.

C. Shop Drawings: Include plans, elevations, and large scale details. Show anchorages and accessory items. Provide location template drawings for items supported or anchored to permanent construction.

1. Furnish roughing-in drawings for electrical service.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility: Provide complete units produced by a single manufacturer, including necessary accessories, fittings and anchorages.

B. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system, and partitions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver projector mounts in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Inspect motorized projector mounts for freight damage, concealed or otherwise, upon delivery to project site. Report damage to freight carrier immediately for replacement of motorized projector lifts.

C. Store projector mounts in resealed manufacturer's original containers.

PART 2 – PRODUCTS

2.01 PROJECTION MOUNTING EQUIPMENT

A. Ceiling-mounted Projector Mounts: Subject to compliance with requirements, provide PJRL40 Universal LCD Projector Mount as manufactured by Peerless Industries or an equal product from one of the following:

1. Bretford Manufacturing Co.
2. Draper shade and Screen Co. Inc.
3. Installation hardware: Provide attachment hardware, fasteners, and other components of type, size, and spacing recommended by manufacturer for complete, functional, secure installation of projector mount.

2.02 FIXED PROJECTOR MOUNT

A. General: The bracket shall be a universal LCD projector mount. It shall feature pitch, roll, and yaw. Furnish as follows:

1. Quick release spring latch for easy removal and installation of the LCD video projector.

2. Constructed of steel and finished in black fused epoxy.
3. UL listed and CSA certified.

B. Accessories:

1. Fasteners: Provide all fasteners required for a complete assembly, including hardware required for affixing the mount to the ceiling.
2. Adjustable Extension Column: Manufacturer's standard extension column. It shall offer a 1' range of height adjustment at 1" increments. The finish shall be matte black fused epoxy.
    a. Provide at all projector ceiling mounts.
3. Ceiling Escutcheon Ring: Manufacturer's standard escutcheon ring.
    a. Provide at all extension columns penetrating a finished ceiling.

PART 3 – EXECUTION

3.01 COORDINATION

A. Coordinate layout and installation of projector mounts with ceiling construction and related components penetrating or above ceilings such as lighting fixtures, mechanical equipment, ductwork, and fire-suppression system.

B. Coordinate requirements for blocking, structural supports, bracing, and ceiling openings to ensure adequate means for installation of projector mounts.

C. Coordinate requirements for power supply conduit, and wiring required for projector mount lifts and controls.

D. Coordinate installation of recessed projector mount lifts with construction of suspended acoustical panel ceilings. Where acoustical ceiling panels are to be adhered to mount closure, provide and coordinate required tolerances and weight restrictions.

E. Coordinate interface and installation of projector mount lift controls with provision of motorized screen.

3.02 INSTALLATION

A. Install projector mounts at locations and heights indicated on Drawings.

B. Install projector mounts complete with necessary hardware, anchors, brackets and fasteners; according to manufacturer's written instructions and as specified.

END OF SECTION

SECTION 12 24 13

ROLLER WINDOW SHADES

PART 1 – GENERAL

1.01 SUMMARY

A. Provide manually operated roller shades as applicable. Provide shades complete with mounting brackets, roller tubes, hembars, hardware and accessories.

1. Work includes local, group and master control systems for shade operation with addressable, encoded, electronic drive units.

B. Related Sections:

1. Basis of Design Colors/Patterns: Refer to Schedule of Finishes on drawings.
2. Section 06 10 00 – Rough Carpentry for wood blocking for mounting roller shades and accessories.
3. Section 09 29 00 – Gypsum Board: Coordination with gypsum board assemblies for blocking, installation of shade pockets, closures and related accessories.
4. Section 09 51 13 – Acoustical Panel Ceilings: Coordination with acoustical ceiling systems for blocking, installation of shade pockets, closures and related accessories.

1.02 ACTION SUBMITTALS

A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
3. Storage and handling requirements and recommendations.
4. Mounting details and installation methods.
5. Typical wiring diagrams including integration of EDU controllers with building management system, audiovisual and lighting control systems as applicable.

C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, power and control wiring diagrams, and relationship to adjacent work.

1. Prepare control, wiring diagrams based on, switching and operational requirements provided by the Architect in electronic format.

D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

E. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shade cloth samples and aluminum finish sample as selected. Mark face of material to indicate interior faces.

1.03 INFORMATIONAL SUBMITTALS

A. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

B. Warranty: Provide manufacturer's warranty documents as specified in this Section.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years' experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section. This includes but is not limited to all required extrusions, accessories, controls and fabricated roller shades or else all stated and published warranties may be void.

B. Installer Qualifications: Engage an installer, which shall assume responsibility for installation of all system components, with the following qualifications.

1. Installer for roller shade system shall be trained and certified by the manufacturer with a minimum of ten years' experience in installing products comparable to those specified in this section.

C. Fire-Test-Response Characteristics: Passes NFPA 701small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

D. Shadecloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, and ATCC9645.

1.05 MOCKUP

A. Before window shade installation, prepare a mock-up for each project condition and type of window shade to verify selections and establish application quality standards. Keep and maintain mock-ups during construction in an undisturbed condition as a standard for judging completed Work. Accepted mock-ups in an undisturbed condition at the time of Project Completion may become part of the final Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

B. Store and protect products under provisions of Section 01 60 00 – Product Requirements.

C. Store in a shades in clean, dry area, laid flat, and blocked off ground to prevent sagging, twisting, or warping.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.08 WARRANTY

A. Warranty: Provide manufacturer's standard warranties, including the following:

1. Roller Shade Hardware, Chain and Shade cloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, basis of design manufacturers and products of the manufacturer are indicated in the Schedule of Finishes on the drawings.

1. Roller Shades (Basis of Design): MechoShade Systems, Inc of Long Island City, NY.

B. Comparable Products: Subject to compliance with requirements, provide the basis-of-design products indicated, or comparable products by one of the following:

1. Hunter Douglas Contract.
2. Lutron Electronics Co., Inc.
3. Nysan Solar Control Inc.; Hunter Douglas Company

C. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.02 MANUALLY OPERATED SHADES

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Stainless steel.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Clip, jamb mount.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criteria are more stringent.

B. Shadebands:

1. Shadeband Material: As indicated on the Interior Finish Legend on the drawings.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As selected by Architect from manufacturer's full range

C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with removable spline fitting integral channel in tube for attaching shade material.

1. Roller Drive-End Location: Right side of inside face of shade.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 4 inches.

2. Endcap Covers: To cover exposed endcaps.
3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.03 ROLLER-SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design.

C. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shade bands. Assure the width-to-height (W:H) ratios shall not exceed manufacturer’s standards. Battens shall be roll-formed stainless steel or tempered steel.

1. All batten / seam locations to be approved by Architect.

D. For railroaded shade bands, provide seams in railroaded multi-width shade bands to meet size and seam alignment requirements. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer’s standards.

E. Blackout shade bands, when used in side channels, shall have horizontally mounted, roll-formed stainless steel or tempered-steel battens not more than 3 feet on center extending fully into the side channels. Battens shall be concealed in an integrally colored fabric to match the inside and outside colors of the shade band, in accordance with manufacturer's published standards for spacing and requirements.

1. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.

F. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lifting Mechanism: With permanently lubricated moving parts.

G. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
2. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

H. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, roller, and operating hardware and for hardware position and shade mounting method indicated.

I. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

J. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

2.04 SHADE BAND

A. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.

1. Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
2. Shade band and Shade Roller Attachment:

a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
b. Provide for positive mechanical engagement with drive / brake mechanism.
c. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snapon" snap-off" spline mounting, without having to remove shade roller from shade brackets.
d. Mounting spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
e. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets are not acceptable.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine openings where shades will be installed prior to beginning installation. Verify that openings are ready to receive the work and that critical dimensions are correct and surface conditions acceptable.

B. Do not proceed with installation until unsatisfactory conditions have been corrected and finishing operations, including painting are completed.

3.02 INSTALLATION

A. Install shades in accordance with manufacturer’s instructions.

B. All shades shall be installed level and plumb, with a maximum offset tolerance of 1/8-inch.

C. Maximum variation of gap at window opening perimeter: 1/4-inch.

D. All fabric seams and hems shall be smooth and free of puckering. All fabric shall be free of wrinkles, and draping of fabric shall be smooth and consistent.

E. Install mounting brackets with at least two fasteners per bracket. Secure in place with flush countersunk fasteners.

3.03 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.04 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems. Refer to Division 01 Sections for contract closeout procedures.

END OF SECTION

SECTION 21 05 17

SLEEVES AND SLEEVE SEALS FOR FIRE PROTECTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Advance Products & Systems
2. GPT
3. Metraflex
4. Pipeline Seal and Insulator.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls and Concrete Slab on Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

END OF SECTION 21 05 17

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SECTION 21 05 18

ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

D. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

E. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed or exposed-rivet hinge; and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with inside diameter closely fitting around outside diameter of piping and piping insulation and with outside diameter completely covering opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Uninsulated Piping: One-piece steel or split-plate steel.
c. Insulated Piping: One-piece stamped steel or split-plate stamped steel.

2. Escutcheons for Existing Piping:

    a. Uninsulated Piping: Split-plate, stamped steel.
    b. Insulated Piping: Split-plate, stamped steel.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 21 05 18

SECTION 21 05 29

HANGERS AND SUPPORTS FOR FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fastener systems.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports.”

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for fire protection piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

1.4 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated.
2. Shop Drawings: Signed and sealed by a qualified professional engineer**.** Show fabrication and installation details and include calculations for the following; include Product Data for components:

    a. Trapeze pipe hangers.

B. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

C. Informational Submittals:

1. Welding certificates.

D. Closeout Submittals:

1. Operation and Maintenance Data

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. SMACNA.

D. Pipe Hanger Standards: Manufacturers Standardization Society (MSS) SP-58, SP-89, and SP-69, as referenced.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

1. B-line Systems, Inc; a division of Cooper Industries.
2. Carpenter & Paterson, Inc.
3. ERICO/Michigan Hanger Co.
4. Globe Pipe Hanger Products, Inc.
5. Grinnell Corp.
6. Hilti North America.
7. National Pipe Hanger Corporation.
8. PHD Manufacturing, Inc.

B. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

C. Saddles

1. Material Galvanized Steel, 180-degree shape, each saddle marked with insulation O.D. Standard manufacturers gauge per insulated pipe size.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.2 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

F. Use padded hangers for piping that is subject to scratching.

G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 21 05 29

SECTION 21 05 53

IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Stencils.
4. Valve tags.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated.
2. Samples: For color, letter style, and graphic representation required for each identification material and device.
3. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
4. Valve numbering scheme.

B. Closeout Submittal:

1. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass: 0.032-inch, stainless steel: 0.025-inch, aluminum: 0.032-inch, or anodized aluminum: 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.

2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.3 STENCILS

A. Stencils for Piping:

1. Lettering Size: Size letters according to ASME A13.1 for piping.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

B. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass: 0.032-inch, stainless steel: 0.025-inch, aluminum: 0.032-inch, or anodized aluminum: 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain, or beaded chain, or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve or control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:

1. Fire Protection Piping:

a. Background: Red.
b. Letter Colors: White.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape: 1-1/2 inches, round.
2. Valve-Tag Colors: Natural.
3. Letter Colors: Black.

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SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Sprinklers.
4. Alarm devices.
5. Backflow Preventer.
6. Pressure gages.

1.2 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.3 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Contractor to perform a flow test and utilize results of flow test for system design.

C. Sprinkler system design shall be reviewed and approved by the design Fire Protection Engineer before being submitted for approval by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

a. Building Service Areas: Ordinary Hazard, Group 1.
b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
c. Elevator Machine Rooms: Ordinary Hazard, Group 1.
d. General Storage Areas: Ordinary Hazard, Group 1.
e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
f. Office and Public Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:

    a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft.

4. Maximum Protection Area per Sprinkler:

    a. Office Spaces: 225 sq. ft.
    b. Storage Areas: 130 sq. ft.
    c. Mechanical Equipment Rooms: 130 sq. ft.
    d. Electrical Equipment Rooms: 130 sq. ft.
    e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

    a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
    b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work. Also include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

    1. Domestic water piping.
    2. Compressed air piping.
    3. HVAC hydronic piping.
    4. Items penetrating finished ceiling include the following: Lighting fixtures, Air outlets and inlets.

E. Qualification Data: For qualified Installer and NICET designer.

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, for approval by the design fire protection engineer before sending for approval by authorities having jurisdiction, including hydraulic calculations if applicable. Identify sprinkler heads by the same designations used in their agency approval documents.

G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

H. Field quality-control reports.

I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems. Base calculations on results of fire-hydrant flow test. Design shall be signed by a NICET Level III or IV and for review by the design FPE.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

D. Grooved Products: If grooved products are used, provide couplings, fittings, valves, and specialties from a single manufacturer.

1.7 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Galvanized, Steel Couplings: ASTM A 865, threaded.

E. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Pressure Rating: 175 psig minimum.
2. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 536, ductile-iron casting; with dimensions matching steel pipe. Short-pattern fittings with flow characteristics similar to standard fittings are acceptable.
3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber center-leg gasket with pipe stop, and ASTM A449 bolts and nuts.

    a. Rigid Type: Housings cast with offsetting angle-pattern bolt pads for rigidity and support. Basis of Design: Victaulic 107N.
    b. Flexible Type: Where vibration attenuation or stress relief are required. Basis of Design: Victaulic 77 or 177.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Grooved-Joint Lubricants: Lubricant approved for the gasket elastomer and fluid media by the grooved-joint coupling manufacturer.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:

1. Standard: UL 1091 except with ball instead of disc.
2. Valves NPS 1-1/2 and Smaller: Bronze or brass body with threaded or grooved ends.
3. Valves NPS 2: Bronze body with threaded ends or ductile-iron body with grooved ends.

C. Check Valves:

1. Standard: UL 312.
2. Pressure Rating: 250 psig minimum.

3. Type: Spring-assisted swing check.
4. Body Material: Ductile iron.
5. End Connections: Flanged or grooved.

D. Bronze OS&Y Gate Valves:

1. Standard: UL 262.
2. Pressure Rating: 175 psig.
3. Body Material: Bronze.
4. End Connections: Threaded.

E. Iron OS&Y Gate Valves:

1. Standard: UL 262.
2. Pressure Rating: 250 psig minimum.
3. Body Material: Cast or ductile iron.
4. End Connections: Flanged or grooved.

F. Indicating-Type Valves:

1. Standard: UL 1091.
2. Pressure Rating: 175 psig minimum.
3. Valves NPS 2 and Smaller:

   a. Valve Type: Ball.
   b. Body Material: Bronze or brass.
   c. End Connections: Threaded or grooved.

4. Valves NPS 2-1/2 and Larger:

   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged, grooved, or wafer.
   d. Seat: Pressure-responsive elastomer.
   e. Stem: Stainless steel, offset from the disc centerline to provide complete seating.

5. Valve Operation: Weatherproof actuator housing with integral electrical, 125-V ac, prewired, single-circuit, supervisory switch indicating device.

2.5 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Standard: UL 193.
2. Design: For horizontal or vertical installation. Valve internal components replaceable without removing valve from piping.

3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages and fill-line attachment with strainer.
4. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Standard: UL 1726.
2. Pressure Rating: 175 psig minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4.
5. End Connections: Threaded.

2.6 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Standard: UL 213.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-T and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection, Test, and Drain Assemblies:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Bronze or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved ends.

C. Branch Line Testers:

1. Standard: UL 199.
2. Pressure Rating: 175 psig.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Brass or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved ends.

E. Adjustable Drop Nipples:

1. Standard: UL 1474.

2. Pressure Rating: 250 psig minimum.
3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:

1. Standard: UL 1474.
2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid. Hose of type 304 stainless steel braid over flexible tube with threaded male fitting or coupling at one end and reducer and female threaded connection at other end. Union joints.
3. Pressure Rating: 175 psig minimum.
4. Size: Same as connected piping, for sprinkler.

2.7 SPRINKLERS

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
3. Sprinklers shall be quick-response type heads. Sprinklers with “O” rings are prohibited.
4. Sprinklers shall have hexagonal wrench boss cast into body.

B. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

C. Open Sprinklers with Heat-Responsive Element Removed: UL 199.

1. Characteristics:

a. Nominal 1/2-inch Orifice: With Discharge Coefficient K between 5.3 and 5.8.
b. Nominal 17/32-inch Orifice: With Discharge Coefficient K between 7.4 and 8.2.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers. Escutcheons listed, furnished, and approved for use with sprinkler heads provided.

1. Ceiling Mounting: Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Plastic, white finish, one piece, flat.

F. Sprinkler Guards:

1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.
3. Guards listed, furnished, and approved for use with sprinkler heads provided.

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Standard: UL 464.
2. Type: Vibrating, metal alarm bell.
3. Size: 8-inch minimum- diameter.
4. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Water-Flow Indicators:

1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated.
5. Pressure Rating: .
6. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.

E. Indicator-Post Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.9 BACKFLOW PREVENTERS

A. Double-Check, Detector-Assembly Backflow Preventers:
1. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or FM Global's "Approval Guide."
2. Operation: Continuous-pressure applications.
3. Pressure Loss: maximum, through middle one-third of flow range.
4. Size: As required per contract documents.
5. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
6. End Connections: Flanged.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:

   a. Valves: UL 262 and FM Global's "Approval Guide" listing; OS&Y gate type with flanged ends on inlet and outlet.
   b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

B. Backflow Preventer Test Kits:
1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.10 PRESSURE GAGES

A. Standard: UL 393.

B. Dial Size: 3-1/2- to 4-1/2-inch diameter.

C. Pressure Gage Range: 0 to 250 psig minimum. Provide pressure

D. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

2.11 FIRE-DEPARTMENT CONNECTION

A. Exposed-type:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. American Fire Hose & Cabinet.
      b. Elkhart Brass Mfg. Company, Inc.
      c. Fire-End & Croker Corporation.
      d. Fire Protection Products, Inc.
      e. GMR International Equipment Corporation.
      f. Guardian Fire Equipment, Inc.
      g. Venus Fire Protection Ltd.
      h. Wilson & Cousins Inc.
   2. Standard: UL 405.
   3. Type: Exposed, projecting, for wall mounting.
   4. Pressure Rating: 175 psig minimum.
   5. Body Material: Corrosion-resistant metal.
   6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
   7. Caps: Brass, lugged type, with gasket and chain.
   8. Escutcheon Plate: Round, brass, wall type.
   9. Outlet: Back, with pipe threads.
   10. Number of Inlets: Two.
   11. Escutcheon Plate Marking: Similar to "AUTO SPKR."
   12. Finish: Rough brass or bronze.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

3.4 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Do not install plastic piping in an air plenum.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Fill sprinkler system piping with water.

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

P. Install sleeve seals for piping penetrations of exterior concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.5 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type fire-department connections.

B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection

3.6 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts in accordance with the manufacturer’s published instructions. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints. Grooved-joint coupling manufacturer to provide factory-trained field representative for on-site training for contractor’s personnel in proper grooved-joint item fabrication and installation procedures. Representative shall periodically visit job site to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.

J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts in accordance with the manufacturer’s published instructions. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints. Grooved-joint coupling manufacturer to provide factory-trained field representative for on-site training for contractor’s personnel in proper grooved-joint item fabrication and installation procedures.

Representative shall periodically visit job site to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.

K. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.7 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.8 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

D. Do not install sprinklers that have been dropped, damaged, show a visible loss of fluid, or have a cracked glass bulb.

E. The sprinkler bulb protector shall be removable by hand without tools or devices that may damage the bulb.

3.9 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.13 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.14 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.

3. Wall Mounting: Sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 13

SECTION 22 05 17

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems
2. GPT
3. Metraflex

4. Pipeline Seal and Insulator.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls and Concrete Slab on Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

END OF SECTION 22 05 17

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SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

D. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

E. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed or exposed-rivet hinge; and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with inside diameter closely fitting around outside diameter of piping and piping insulation and with outside diameter completely covering opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Uninsulated Piping: One-piece steel or split-plate steel.
c. Insulated Piping: One-piece stamped steel or split-plate stamped steel.

2. Escutcheons for Existing Piping:

a. Uninsulated Piping: Split-plate, stamped steel.
b. Insulated Piping: Split-plate, stamped steel.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 22 05 18

SECTION 22 05 19

METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Thermowells.
5. Dial-type pressure gauges.
6. Gauge attachments.
7. Test plugs.
8. Test-plug kits.
9. Sight flow indicators.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gauge, from manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ashcroft Inc.
2. Ernst Flow Industries.
3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Noshok.
7. Palmer Wahl Instrumentation Group.
8. REOTEMP Instrument Corporation.
9. Tel-Tru Manufacturing Company.

10. Trerice, H. O. Co.
11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
12. Weiss Instruments, Inc.
13. WIKA Instrument Corporation - USA.
14. Winters Instruments - U.S.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.

D. Dial: Non reflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable angle rigid, back and rigid, bottom, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass or plastic.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1.5 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Ashcroft Inc.
    b. Marsh Bellofram.
    c. Miljoco Corporation.
    d. Palmer Wahl Instrumentation Group.
    e. REOTEMP Instrument Corporation.
    f. Trerice, H. O. Co.
    g. Weiss Instruments, Inc.

2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn steel; 5-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic
9. Ring: Stainless steel
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device rigid, back and rigid, bottom; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

a. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Ashcroft, Trerice, Weiss

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
9. Design for Thermowell Installation: Bare stem.
10. Connector: 3/4 inch, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.4 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: Brass, type 304 stainless steel, or type 316 stainless steel.
4. Material for Use with Steel Piping: Type 304 stainless steel or type 316 stainless steel..
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.5 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:

1. Manufacturers: Ashcroft, Trerice, Weiss

2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 6-inchnominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.

8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.6 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.7 TEST PLUGS

A. Manufacturers: Trerice, Weiss, Watts

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.8 SIGHT FLOW INDICATORS

A. Manufacturers: Dwyer, OPW, Archon Industries

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

H. Install remote-mounted pressure gauges on panel.

I. Install valve and snubber in piping for each pressure gauge for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.

L. Install pressure gauges in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Direct metal case, vapor-actuated type.
3. Industrial-style, liquid-in-glass type.
4. Direct-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Direct mounted, metal case, vapor-actuated type.
3. Industrial-style, liquid-in-glass type.
4. Direct mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping0 to 100 deg F and minus 20 to plus 50 deg C.

B. Scale Range for Domestic Hot-Water Piping:0 to 250 deg F.

C. Scale Range for Domestic Cooled-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.

3.6 PRESSURE-GAUGE SCHEDULE

A. Pressure gauges at discharge of each water service into building shall be one of the following:

1. Liquid-filled, direct mounted, metal case.
2. Sealed, direct mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

B. Pressure gauges at inlet and outlet of each water pressure-reducing valve shall be the following:

1. Liquid-filled, direct mounted, metal case.
2. Sealed, direct mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

C. Pressure gauges at suction and discharge of each domestic water pump shall be the following:

1. Liquid-filled, direct mounted, metal case.
2. Sealed, direct mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi and 0 to 1100 kPa.

B. Scale Range for Domestic Water Piping: 0 to 160 psi and 0 to 1100 kPa.

END OF SECTION 22 05 19

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Combination balancing and shutoff valves.
5. Gate valves.
6. Globe valves.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NPS: Nominal Pipe Size

D. OS&Y: Outside screw and yoke.

E. SWP: Steam working pressure.

1.3 SUBMITTALS

A. Product Data: For each type of valve indicated, include: Body, seating and trim materials; valve design; pressure and temperature classifications; end connections, arrangements; dimensions and required clearances. Submit pressure drop curves for no-slam check valves. Include a list indicating valve type and its piping system application. Include rated capacities; shipping and operating weights and furnished specialties and accessories.

B. Contract Closeout Information:

1. Valve chart indicating valve identification number, valve type, service, manufacturer and model number, and location of valve.
2. Operating and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
1. Grooved end valves shall be of the same manufacturer as adjoining couplings.

B. UL Compliance:

1. NSF-61 for valves in potable water systems.
2. NSF-372 for low-lead requirements.

C. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.
4. ASME Boiler Code Specifications for Boiler Room valves.

D. ASTM Compliance:

1. ASTM B62 for 125 psi and 150 psi saturated steam rated valve pressure containing parts.
2. ASTM B61 for 200 psi and 300 psi valves with metallic seats.

E. Factory test all valve bodies, shells and seats per MSS requirements at a minimum.

F. Iron Body Valves

1. Pressure-Containing Parts: ASTM A126, Grade B or ASTM A536, Grade 65-45-12.
2. Face-to-Face and End-to-End Dimensions: ANSI B16.10.
3. Design, Workmanship, Materials, Testing: MSS SP-70, 71, 85.

G. Butterfly Valves

1. Face-to-Face and End-to-End Dimensions: MSS SP-67.

H. Valve Stems: ASTM B371, Alloy C69400; ASTM B371, Alloy C65100H04 (rolled silicon brass); or other material equally resistant to dezincification.

I. Valve Bypass and Drain Connections: MSS SP-45.

J. Pressure casting shall be free of impregnating materials, no welding of iron allowed.

K. Manufacturer’s name or trademark and working pressure stamped or cast into body.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooved ends, and weld ends.
3. Set gate and globe valves closed to prevent rattling.
4. Set ball valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

B. Gate, Ball, Butterfly, Check, and Globe Valves:
   1. Milwaukee, Hammond, Crane, NIBCO, DeZurik, Watts, Tyco, Mueller or Victaulic.

C. Combination Balancing and Shutoff Valves:
   1. Armstrong, Bell & Gossett, Griswold, Taco, IMI Hydronic Engineering or Victaulic.

2.2 GENERAL REQUIREMENTS FOR VALVES

A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures. Valves shall be rated for pressures and temperatures no less than 20% over that of the piping system in which they are installed. Account for piping system pressure tests when selecting component ratings.

B. Valve Sizes: Same as upstream piping unless otherwise indicated.

C. Valve Actuator Types:

   1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
   2. Handwheel: For valves other than quarter-turn types.
   3. Hand lever: For quarter-turn valves NPS 6 and smaller.

D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

   1. Gate Valves: With rising stem.
   2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   3. Butterfly Valves: With extended neck.

E. Valve-End Connections:

   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Threaded: With threads according to ASME B1.20.1.

F. Combination Balancing and Shutoff Valves:

   1. Install where shown on Drawings. Valves shall be designed and used only for balancing, not shutoff.
   2. Provide a means for connecting to a portable differential pressure meter for readout. A portable pressure gauge, hoses and flow curves shall be provided in a portable test kit.
   3. On sizes 2-1/2” and larger, valve size, capacity and operating pressure must comply with ASME Boiler Pressure Vessel Code: Section IV.
   4. Refer to manufacturer’s recommendations for upstream and downstream straight piping lengths.
   5. Provide an additional “separate” shutoff valve upstream of combination valves for system/component shutoff.

2.3 BALL VALVES

A. Bronze Ball Valves:

1. Description:

a. Standard: MSS SP-110.
b. ANSI Class: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded or Soldered for copper piping.
g. Seats: Reinforced PTFE.
h. Stem: Stainless steel.
i. Ball: Chrome plate ball, vented.
j. Port: Full.
k. Operator: Hand Lever.

2.4 BUTTERFLY VALVES

A. Single-Flange, Butterfly Valves:

1. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.
h. Operator: 10 Position Hand Lever for less than 6”, Gear Actuator for 6” and larger.
i. Other: Valves and Seats shall be rated for 150 psi shutoff during dead-end service, without downstream piping or flange.

2.5 CHECK VALVES

A. Bronze Swing Check Valves:

1. Description:

a. Standard: MSS SP-80, Type 3.
b. ANSI Class: 125
c. CWP Rating: 200 psig.
d. Body Design: Horizontal flow.
e. Body Material: ASTM B 62, bronze.
f. Ends: Threaded or Soldered for copper piping.
g. Disc: Reinforced PTFE.
h. Cap: Threaded.

B. Iron Swing Check Valves:

1. Description:

a. Standard: MSS SP-71, Type I.

b. ANSI Class: 125
c. CWP Rating: 200 psig.
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, cast iron.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.
i. Cap: Bolted.

C. Cast Steel Swing Check Valves:

1. Description:

a. ANSI Class: 300
b. Body Material: ASTM A 216, cast steel.
c. Disc Material (2" to 4"): Steel (ASTM A 217, Gr. CA-15).
d. Disc Material (6" to 12"): Steel with Hard Faced (ASTM A 216, Gr. WCB).
e. Ends: Flanged.
f. Seat Ring Material: Stellite hard facing over plain carbon steel.
g. Bonnet: Bolted.

2.6 COMBINATION BALANCING AND SHUTOFF VALVES

A. Calibrated Ball Type or Venturi Combination Balancing and Shutoff Valves:

1. Description:

a. CWP Rating: 125 psig.
b. Body Material: Brass or Bronze (ASTM B 62)
c. Ends: Flanged, Threaded or Soldered for copper piping.
d. Seat Material: Double-seated Teflon.
e. Ball Material: Stainless Steel.
f. Stem Material: Brass/Bronze sealed with blow-out proof EPDM O-Ring.
g. Operator: Lever with memory stop.

2.7 GATE VALVES

A. Bronze Gate Valves:

1. Description:

a. Standard: MSS SP-80, Type 2.
b. ANSI Class: 150
c. CWP Rating: 300 psig.
d. Body Material: ASTM B 62, cast bronze.
e. Ends: Threaded.
f. Stem: Non-Rising.
g. Disc: Solid wedge; bronze.
h. Packing: Asbestos free.
i. Bonnet: Union
j. Operator: Hand Wheel-Malleable iron.

B. Iron Gate Valves:

1. Description:

a. Standard: MSS SP-70, Type I.
b. ANSI Class: 125
c. CWP Rating: 200 psig.
d. Body Material: ASTM A 126, cast iron.
e. Ends: Flanged.
f. Wedge and Seat Rings Material: Cast bronze.
g. Disc: Solid Wedge-Cast iron.
h. Packing and Gasket: Asbestos free.
i. Bonnet: Bolted
j. Stem: O.S. & Y.
k. Operator: Hand Wheel-Cast iron.

C. Forged Carbon Steel Gate Valves:

1. Description:

a. ANSI Class: 300 or 600
b. Body Material: ASTM A 105, forged carbon steel.
c. Ends: Flanged or weld.
d. Seat Ring Material: Hard faced stainless steel (Type 410).
e. Disc: Solid Wedge-Stainless steel (Type 410).
f. Bonnet: Bolted
g. Packing and Gasket: Asbestos free.
h. Stem: O.S. & Y.
i. Operator: Hand Wheel-Malleable iron.

D. Cast Steel Gate Valves:

1. Description:

a. ANSI Class: 300
b. Body Material: ASTM A 216, cast steel.
c. Ends: Flanged.
d. Seat Ring Material: Stellite hard facing over plain carbon steel.
e. Disc: Stainless steel (ASTM A 217).
f. Bonnet: Bolted.
g. Stem: O.S. & Y.
h. Operator: Hand Wheel-Malleable iron.

2.8 GLOBE VALVES

A. Bronze Globe Valves:

1. Description:

a. Standard: MSS SP-80, Type 2.
b. ANSI Class: 150
c. Body Material: ASTM B 62, bronze.
d. Ends: Threaded or Flanged.
e. Stem: Rising.
f. Disc: 420 Stainless Steel.
g. Seat Ring Material: 420 Stainless Steel.
h. Bonnet: Union.
i. Operator: Hand Wheel-Malleable iron.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves at locations shown on the Drawings, per the Specifications and in accordance with manufacturer's written instructions.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Unions and flanges for servicing and disconnect are not required in installations using grooved mechanical joint couplings (the couplings shall serve as disconnect points if required).

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with handwheel and stem at or above center of pipe.

F. Install valves in position to allow full stem movement.

G. Install check valves for proper direction of flow and as follows: Swing Check Valves: In horizontal position with hinge pin level.

H. Install Combination Balancing and Shutoff Valves at each branch connection to return main.

I. Install Start/Stop flow valve for isolation at each branch connection to supply main.

J. Install check valves at each pump discharge and elsewhere as required to control flow direction.

K. All check valves should be installed in a location that has smooth and laminar flow conditions.

L. For swing type check valves, locate valve a minimum of 10 pipe diameters downstream of a reciprocating pump or other turbulence inducing device such as an elbow or tee. Locate elbows, reductions, etc. a minimum of 5 pipe diameters downstream of valve.

M. Valves installed in copper lines shall be provided with screwed or flanged adapters with a union installed downstream and within 12" of the valve.

N. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and

pipe drain to nearest floor drain or as indicated on the Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

3.5 PLUMBING SYSTEMS

A. Pipe NPS 2 and Smaller:

1. Shutoff: Ball Valves.
2. Prevent Backflow: Lift Check Valves or Bronze Swing Check Valves.
3. Regulate/Balance Flow: Calibrated Ball Type or Venturi Combination Balancing Shutoff Valves.

B. Pipe NPS 2-1/2 and Larger:

1. Shutoff: Butterfly Valves.
2. Prevent Backflow: Iron Swing Check Valves or Globe Body Silent Check Valves.
3. Regulate/Balance Flow: Venturi Butterfly or Venturi Globe Type Combination Balancing and Shutoff Valves.

END OF SECTION 22 05 23

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning system.
6. Equipment supports.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports.”

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

1.4 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated.
2. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

    a. Trapeze pipe hangers.
    b. Pipe positioning system.
    c. Equipment supports.

3. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

    a. Detail fabrication and assembly of trapeze hangers.
    b. Design Calculations: Calculate requirements for designing trapeze hangers.

B. Informational Submittals:

1. Welding certificates.

C. Closeout Submittals:

1. Operation and Maintenance Data.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. SMACNA.

D. Pipe Hanger Standards: Manufacturers Standardization Society (MSS) SP-58, SP-89, and SP-69, as referenced.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. B-line Systems, Inc; a division of Cooper Industries.
2. Carpenter & Paterson, Inc.
3. ERICO/Michigan Hanger Co.
4. Globe Pipe Hanger Products, Inc.
5. Grinnell Corp.
6. Hilti North America.
7. National Pipe Hanger Corporation.
8. PHD Manufacturing, Inc.

B. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

C. Saddles

1. Material Galvanized Steel, 180-degree shape, each saddle marked with insulation O.D. Standard manufacturers gauge per insulated pipe size.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Carpenter & Paterson, Inc.
2. ERICO International Corporation.
3. National Pipe Hanger Corporation.
4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating Below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

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SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated.
2. Samples: For color, letter style, and graphic representation required for each identification material and device.
3. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
4. Valve numbering scheme.

B. Closeout Submittal:

1. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass: 0.032-inch, stainless steel: 0.025-inch, aluminum: 0.032-inch, or anodized aluminum: 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 STENCILS

A. Stencils for Piping:

1. Lettering Size: Size letters according to ASME A13.1 for piping.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

B. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass: 0.032-inch, stainless steel: 0.025-inch, aluminum: 0.032-inch, or anodized aluminum: 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain, or beaded chain, or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve or control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both side of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:

1. Domestic Water Piping

    a. Background: Green.
    b. Letter Colors: White.

2. Sanitary Waste and Storm Drainage Piping:

    a. Background Color: Green.
    b. Letter Color: White.

3. Fuel Gas Piping:

    a. Background Color: Yellow.
    b. Letter Color: Black.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape: 1-1/2 inches, round.
2. Valve-Tag Colors: Natural.
3. Letter Colors: Black.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

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SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating plumbing piping systems.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Protection: Do not permit mineral fiber or calcium silicate insulation to get wet. Mineral fiber or calcium silicate insulation that is or has been wet shall be removed from the project site.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping Installer for piping insulation application.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Non-flexible Fiberglass

1. O-C fiberglass ASJ/SSL-II pipe insulation with all service jacket (ASJ).
2. Thermal conductivity (K value): Not greater than 0.23 at mean temperature of 75 deg F.
3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

    a. Manville
    b. Owens Corning Insulating Systems, LLC.
    c. Manson
    d. Knauf.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

    a. Aeroflex USA, Inc.
    b. Armacell LLC.
    c. K-Flex USA.

2. Properties:

    a. Maximum Operating Temperature: 180 deg F.
    b. Minimum Operating Temperature: -70 deg F.
    c. Maximum Thermal Conductivity at 75 deg F Mean Temperature: Thickness 1 Inch or Less: 0.245 Btu-in/hr-ft^2-deg F.
    d. Maximum Water Vapor Permeability Thickness 1 Inch or Less: 0.05 perm-inches.
    e. Maximum Water Absorption by Volume: 0.2%.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. All-Service Jacket (ASJ): White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I. Maximum water vapor permeance 0.02 perms.
2. All-Service Jacket – Self-Sealing Lap (ASJ-SSL): ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I. Maximum water vapor permeance 0.02 perms.
3. Foil-Scrim Kraft (FSK) Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II. Maximum water vapor permeance 0.02 perms.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Adhesive as recommended by jacket material manufacturer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

   a. Johns Manville; Ceel-Co or Zeston.
   b. P.I.C. Plastics, Inc.; FG Series.
   c. Proto Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Color: White unless indicated otherwise.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.
    b. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.

2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

    a. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.
    b. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.

E. Self-Adhesive Indoor or Outdoor Jacket: Multiple-ply laminated vapor barrier and waterproofing membrane for installation over insulation; consisting of aluminum, Tedlar, or laminate sheet with integral acrylic peel-and-stick adhesive with white, silver, or black facing as indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

    a. 3M; VentureClad.
    b. Polyguard Products, Inc.; Alumaguard 60.

F. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

G. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

H. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

2.10 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:
1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation in accordance with manufacturers' instructions.

B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system.

D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

H. Keep insulation materials dry during application and finishing. Mineral fiber or calcium silicate insulation that is or has been wet shall be removed from the job site.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical.

K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches on center.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches on center. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation to less than 75 percent of its nominal thickness.

O. Repair joint separations and cracking due to thermal movement.

P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in firestopping section.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in firestopping section.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is more. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is more. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is more.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF NON-FLEXIBLE PIPE INSULATION

A. On piping, install with lap joint attached using outward clinching staples, 3-inch centers, 1/4 inch from edge on hot piping. On cold piping, use self-sealing lap system or adhesive applied to both surfaces per manufacturer's recommendation. Do not staple cold piping. Butt adjoining sections of insulation tightly together and continue jacket by installing self-adhering butt strips over entire circumferential joint.

B. Installation of Insulation of Fittings

1. For pipe sizes 2 inches and smaller, finish with mineral fiber cement to thickness of adjoining pipe insulation.
2. Over 2 inches, insulate with mitered pipe insulation segments or preformed fiberglass fittings secured with vinyl faced insulation strapping tape or 20 ga galvanized annealed wire and finished with one coat of mineral fiber cement.
3. After cement is dry, finish with Glass Fab and seal with Foster 30-36 adhesive.
4. Prefabricated fitting covers approved for use at pipe fittings may be used instead of finishing method outlined above.
5. Install in accordance with manufacturer's recommendations

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches on center and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped along length of roll with 2-inch-overlap seal. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.9 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as indicated. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 2 or Smaller: Insulation shall be one of the following:

a. Fiberglass: 1/2 inches thick
b. Flexible Elastomeric: 1/2 inch thick.

2. NPS 2-1/2 or Larger: Insulation shall be one of the following:

a. Fiberglass: 1 inches thick

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/2 or Smaller: Insulation shall be one of the following:

a. Fiberglass: 1 inches thick

2. NPS 2 and Larger: Insulation shall be one of the following:

a. Fiberglass: 1-1/2 inches thick

C. Storm Water, Roof Drain, and Overflow Roof Drain (Including Drain Bodies):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Fiberglass: 1 inches thick
b. Flexible Elastomeric: 1 inch thick.

D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be as described in Protective Shielding Guards article above.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed: None.

D. Piping, Exposed:

1. PVC, Color-Coded by System: 20 mils thick.
2. Aluminum, Smooth: 0.020 inch thick.
3. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish: 0.016 inch thick.

END OF SECTION 22 07 19

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aboveground domestic water pipes, tubes, and fittings inside buildings.

1.2 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. Product Data: For grooved-joint couplings and fittings.

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. NSF Compliance:

1. NSF-61 for components in potable water systems.
2. NSF-372 for low-lead requirements.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

G. Copper Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

   a. Elkhart Products Corporation.
   b. NIBCO Inc.
   c. Viega.

2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

   a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
   b. Central Plastics Company.

c. Hart Industries International, Inc.
d. Jomar International.
e. Matco-Norca.
f. McDonald, A. Y. Mfg. Co.
g. Watts; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.
c. Matco-Norca.
d. Watts; a division of Watts Water Technologies, Inc.
e. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

a. Elster Perfection Corporation.
b. Grinnell Mechanical Products; Tyco Fire Products LP.
c. Matco-Norca.
d. Precision Plumbing Products, Inc.
e. Victaulic Company.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.

6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

D. Install shutoff valve immediately upstream of each dielectric fitting.

E. Install domestic water piping level without pitch and plumb.

F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Do not install plastic piping in an air plenum.

K. Install piping to permit valve servicing.

L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

P. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits or nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

G. Install supports for vertical steel piping every 15 feet.

H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:
        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Aboveground domestic water piping, NPS 2 and smaller shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

D. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 22 11 16

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SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers.
6. Outlet boxes.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Air vents.
12. Flexible connectors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

    a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    b. Cash Acme; a division of Reliance Worldwide Corporation.
    c. Conbraco Industries, Inc.
    d. FEBCO; a division of Watts Water Technologies, Inc.
    e. Rain Bird Corporation.
    f. Toro Company (The); Irrigation Div.
    g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

    a. Arrowhead Brass Products.
    b. Cash Acme; a division of Reliance Worldwide Corporation.
    c. Conbraco Industries, Inc.
    d. Legend Valve.
    e. MIFAB, Inc.
    f. Prier Products, Inc.
    g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
    j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated

C. Pressure Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

    a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    b. Conbraco Industries, Inc.
    c. FEBCO; a division of Watts Water Technologies, Inc.
    d. Flomatic Corporation.
    e. Toro Company (The); Irrigation Div.

f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: See DrawingsDesign Flow Rate: See Drawings
6. Selected Unit Flow Range Limits: See Drawings
7. Pressure Loss at Design Flow Rate: See Drawings
8. Accessories:

a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

a. Conbraco Industries, Inc.
b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8 or NPS 1/2 or NPS 3/4 or NPS 1.
5. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
b. Conbraco Industries, Inc.
c. FEBCO; a division of Watts Water Technologies, Inc.
d. Flomatic Corporation.
e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: See Drawings
6. Design Flow Rate: See Drawings
7. Selected Unit Flow Range Limits: See Drawings
8. Body: Bronze for NPS 2 and smaller; steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
10. Configuration: Designed for horizontal, straight-throughflow.
11. Accessories:

a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

B. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

    a. Conbraco Industries, Inc.
    b. FEBCO; a division of Watts Water Technologies, Inc.
    c. Flomatic Corporation.
    d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

    a. Armstrong International, Inc.
    b. Flo Fab Inc.
    c. ITT Corporation; Bell & Gossett Div.
    d. NIBCO Inc.
    e. TAC.
    f. TACO Incorporated.
    g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Type: Ball valve with two readout ports and memory-setting indicator.
3. Body: Brass or bronze.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

    a. Armstrong International, Inc.
    b. Flo Fab Inc.
    c. ITT Corporation; Bell & Gossett Div.
    d. NIBCO Inc.
    e. TAC.
    f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

    a. Conbraco Industries, Inc.
    b. Crane Co.; Crane Valve Group; Crane Valves.

c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO Inc.
h. Red-White Valve Corp.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

E. Automatic Flow-Control Valves for Drinking Water Applications:

1. Description:

a. NSF 61-G rated for commercial hot water service temperature up to 180 F.
b. NSF 372 lead-free construction.
c. Series 300 stainless-steel body.
d. All stainless steel wetted parts.
e. Tamper-resistant flow cartridge of series 300 stainless steel.
f. Basis of Design: Victaulic ICSS Series 76X.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

a. Armstrong International, Inc.
b. Lawler Manufacturing Company, Inc.
c. Leonard Valve Company.
d. Powers; a division of Watts Water Technologies, Inc.
e. Symmons Industries, Inc.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded and union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Rough bronze.
9. Piping Finish: Copper.
10. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

B. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

a. Cash Acme; a division of Reliance Worldwide Corporation.
b. Conbraco Industries, Inc.
c. Honeywell International Inc.
d. Lawler Manufacturing Company, Inc.
e. Leonard Valve Company.
f. Powers; a division of Watts Water Technologies, Inc.
g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Drain: Pipe plug.

2.8 OUTLET BOXES

A. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

a. Acorn Engineering Company.
b. IPS Corporation.
c. LSP Products Group, Inc.
d. Oatey.
e. Plastic Oddities.

2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.

2.9 HOSE BIBBS

A. Hose Bibbs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Watts Drainage Products.
e. Woodford Manufacturing Company; a division of WCM Industries, Inc.
f. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products

2. Standard: ASME A112.18.1 for sediment faucets.
3. Include operating key with each operating-key hose bibb.

2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Josam Company.
    b. MIFAB, Inc.
    c. Prier Products, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products.
    g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
2. Operating Keys(s): Two with each wall hydrant.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

    a. AMTROL, Inc.
    b. Josam Company.
    c. MIFAB, Inc.
    d. Precision Plumbing Products, Inc.
    e. Sioux Chief Manufacturing Company, Inc.
    f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    g. Tyler Pipe; Wade Div.
    h. Watts Drainage Products.
    i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Inlet and Vent Outlet End Connections: Threaded.

2.14 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld Incorporated.
5. Hyspan Precision Products, Inc.
6. Mercer Gasket & Shim, Inc.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. TOZEN Corporation.
10. Unaflex.Universal Metal Hose; a Hyspan company.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install balancing valves in locations where they can easily be adjusted.

C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

D. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

E. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.

F. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.

G. Install water-hammer arresters in water piping according to PDI-WH 201.

H. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Calibrated balancing valves.
4. Primary, thermostatic, water mixing valves.
5. Outlet boxes.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections: Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 22 11 19

SECTION 22 11 24

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Manual gas shutoff valves.
5. Pressure regulators.
6. Dielectric fittings.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Service meters. Indicate pressure ratings and capacities. Include meter bars and supports.
6. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot .
2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

C. Qualification Data: For qualified professional engineer.

D. Welding certificates.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.9 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Construction Manager's written permission.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig or 100 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 5 psig.

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig and is reduced to secondary pressure of 0.5 psig or less.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

a. Material Group: 1.1.
b. End Connections: Threaded or butt welding to match pipe.
c. Lapped Face: Not permitted underground.

d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

6. Mechanical Couplings:
a. Steel flanges and tube with epoxy finish.
b. Buna-nitrile seals.
c. Steel bolts, washers, and nuts.
d. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
e. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
1. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
2. Coating: PE with flame retardant.

a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1) Flame-Spread Index: 25 or less.
2) Smoke-Developed Index: 50 or less.

3. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
4. Striker Plates: Steel, designed to protect tubing from penetrations.
5. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
6. Operating-Pressure Rating: 5 psig.

C. PE Pipe: ASTM D 2513, SDR 11.

1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated, and leak tested.

a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
c. Aboveground Portion: PE transition fitting.
d. Outlet shall be threaded or flanged or suitable for welded connection.
e. Tracer wire connection.
f. Ultraviolet shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

4. Transition Service-Line Risers: Factory fabricated, and leak tested.

a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
b. Outlet shall be threaded or flanged or suitable for welded connection.
c. Bridging sleeve over mechanical coupling.
d. Factory-connected anode.
e. Tracer wire connection.
f. Ultraviolet shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

5. Plastic Mechanical Couplings, NPS 1-1/2 and Smaller: Capable of joining PE pipe to PE pipe.
   a. PE body with molded-in, stainless-steel support ring.
   b. Buna-nitrile seals.
   c. Acetal collets.
   d. Electro-zinc-plated steel stiffener.

6. Plastic Mechanical Couplings, NPS 2 and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
   a. Fiber-reinforced plastic body.
   b. PE body tube.
   c. Buna-nitrile seals.
   d. Acetal collets.
   e. Stainless-steel bolts, nuts, and washers.

7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
   a. Steel flanges and tube with epoxy finish.
   b. Buna-nitrile seals.
   c. Steel bolts, washers, and nuts.
   d. Factory-installed anode for steel-body couplings installed underground.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.

4. CWP Rating: 125 psig.

D. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

E. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig .
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inchesto NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. BrassCraft
   b. Conbraco
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Lee Brass
   b. McDonald
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. McDonald
   b. Mueller
   c. Xomox
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Homestead
   b. McDonald
   c. Mueller

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Meter
   b. Fisher
   c. Invensys
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Meter
   b. Fisher
   c. Invensys
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 10 psig .

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Eaton
   b. Harper
   c. Maxitrol
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Watts
   b. McDonald
   c. Wilkins

2. Description:

   a. Standard: ASSE 1079.
   b. Pressure Rating: 125 psig minimum at 180 deg F.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.8 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.

4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

    a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:

    a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.6 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.

3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.8 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 PAINTING

A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    c. Topcoat: Exterior alkyd enamel gloss.
    d. Color: Gray.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Interior latex matching topcoat.
    c. Topcoat: Interior latex gloss.
    d. Color: Gray.

2. Alkyd System: MPI INT 5.1E.

    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Interior alkyd matching topcoat.
    c. Topcoat: Interior alkyd gloss.
    d. Color: Gray.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections: Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be the following:

1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, lubricated plug valve.

E. Valves in branch piping for single appliance shall be the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

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SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Extra Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ANACO-Husky.
    b. Clamp-All Corp.
    c. Dallas Specialty & Mfg. Co.
    d. MIFAB, Inc.
    e. Mission Rubber Company; a division of MCP Industries, Inc.
    f. Ideal Tridon
    g. Tyler Pipe.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Steel Pipe Pressure Fittings:

1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

2.5 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Do not install plastic piping in an air plenum.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 1 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

O. Install steel piping according to applicable plumbing code.

P. Install aboveground PVC piping according to ASTM D 2665.

Q. Install underground PVC piping according to ASTM D 2321.

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting, **[valve,]** and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

I. Install supports for vertical PVC piping every 48 inches.

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this

pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.9 PIPING SCHEDULE

A. Aboveground, soil, waste and vent piping NPS 4 and smaller shall be one of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings]; CISPI heavy-duty hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

B. Underground, soil, waste, and vent piping NPS 4 and smaller shall be one of the following:

1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 22 13 16

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SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Through-penetration firestop assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements.

B. Coordinate size and location of roof penetrations.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Josam Company.
      2) MIFAB, Inc.
      3) Smith, Jay R. Mfg. Co.
      4) Tyler Pipe.
      5) Watts Drainage Products.
      6) Zurn Plumbing Products Group.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Josam Company.
      2) Oatey.

3) Sioux Chief Manufacturing Co., Inc.
4) Smith, Jay R. Mfg. Co.
5) Tyler Pipe.
6) Watts Drainage Products.
7) Zurn Plumbing Products Group.

2. Standard: ASME A112.36.2M.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Plastic Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Canplas LLC.
b. IPS Corporation.
c. NDS Inc.
d. Plastic Oddities.
e. Sioux Chief Manufacturing Company, Inc.
2. Body: PVC.
3. Closure Plug: PVC.
4. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Commercial Enameling Co.
b. Josam Company; Josam Div.
c. MIFAB, Inc.
d. Prier Products, Inc.
e. Smith, Jay R. Mfg. Co.
f. Tyler Pipe; Wade Div.
g. Watts Drainage Products.
h. Zurn Plumbing Products Group.

2. Standard: ASME A112.6.3.

B. Plastic Floor Drains:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Canplas LLC.
    b. IPS Corporation.
    c. Josam Company; Josam Div.
    d. Oatey.
    e. Plastic Oddities; a division of Diverse Corporate Technologies.
    f. Sioux Chief Manufacturing Company, Inc.
    g. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.6.3.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.

D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.

E. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.

2.5 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft..
2. Vent Pipe Flashing: 8 oz./sq. ft..

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

F. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

G. Assemble open drain fittings and install with top of hub 2 inches above floor.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

J. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

K. Install wood-blocking reinforcement for wall-mounting-type specialties.

L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required: Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

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SECTION 22 14 13

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Extra Heavy classes.

B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Husky
   b. Fernco
   c. MIFAB
   d. Mission
   e. Tyler

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stops.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Do not install plastic piping in an air plenum.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm-Drainage Piping: 1 downward in direction of flow.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

O. Install aboveground PVC piping according to ASTM D 2665.

P. Install underground PVC piping according to ASTM D 2321.

Q. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

H. Install supports for vertical PVC piping every 48 inches.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE

A. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:
1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.

2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

B. Aboveground, storm drainage piping NPS 8 and larger shall be any of the following:
1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
2. Galvanized-steel pipe, drainage fittings, and threaded joints.

C. Underground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Extra Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground, storm drainage piping NPS 8 and larger shall be any of the following:

1. Extra Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 22 14 13

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SECTION 22 14 23

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof drains.
2. Cleanouts.
3. Through-penetration firestop assemblies.
4. Flashing materials.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, General-Purpose Roof Drains, Downspout Nozzles, Promenade Roof Drains:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Josam
   b. MIFAB
   c. Jay R. Smith
   d. Watts
   e. Zurn.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Josam Company.
      2) MIFAB, Inc.
      3) Smith, Jay R. Mfg. Co.

4) Tyler Pipe.
5) Watts Drainage Products.
6) Zurn Plumbing Products Group.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Josam Company.
      2) Oatey.
      3) Sioux Chief Manufacturing Co., Inc.
      4) Smith, Jay R. Mfg. Co.
      5) Tyler Pipe.
      6) Watts Drainage Products.
      7) Zurn Plumbing Products Group.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Plastic Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Canplas LLC.
   b. IPS Corporation.
   c. NDS Inc.
   d. Plastic Oddities.
   e. Sioux Chief Manufacturing Company, Inc.
2. Body: PVC.
3. Closure Plug: PVC.
4. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.3 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M,12 oz./sq. ft.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

F. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23

SECTION 22 34 00

FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Wiring Diagrams: For power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of commercial, gas-fired domestic-water heater, from manufacturer.

B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

C. Source quality-control reports.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.

C. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including storage tank and supports.
   b. Faulty operation of controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

   a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:

      1) Storage Tank: Three years.
      2) Controls and Other Components: One year(s).

   b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:

1. Manufacturers: Bradford White, Lochinvar, Rheem, A.O. Smith, State.

2. Standard: ANSI Z21.10.3/CSA 4.3.

3. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.

   a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

      1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

4. Factory-Installed Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
e. Jacket: Steel with enameled finish.
f. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural-gas fuel.
g. Temperature Control: Adjustable thermostat.
h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. A.O. Smith Amtrol
b.
c. Taco.

2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Air-Charging Valve: Factory installed.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.

F. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include pressure rating as required to match gas supply.

G. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

H. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

I. Pressure Relief Valves: Include pressure setting less than domestic-water heater working-pressure rating.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

J. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.

K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

M. Recirculating Pumps: In-line all-bronze pump with gauge ports at nozzles and with vent and drain ports. Mechanical seal with ceramic seat and carbon seal ring suitable for continuous operation at 225 deg F. Built-in overload protection. 1750 rpm, drip-proof-type motor, maximum rating of working pressure up to 175 psi
1. Manufacturers: Bell & Gossett, Grundfos, TACO, Amtrol

N. Aquastats: Thermostat for controlling pump based on water temperature. Strap-on or insertion bulb type.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC WATER HEATER INSTALLATION

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base.

1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

C. Install gas-fired, domestic-water heaters according to NFPA 54.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 221124 "Facility Natural-Gas Piping."

D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

I. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

J. Fill domestic-water heaters with water.

K. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."

B. Comply with requirements for gas piping specified in Section 221124 "Facility Natural-Gas Piping."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

END OF SECTION 22 34 00

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Work of this Section includes, but is not limited to:

1. Inclusion of all plumbing fixtures, complete and ready for use. All fixtures, except as otherwise specified, shall be constructed of vitreous china with all visible exposed surfaces glazed.
2. Providing all stops, traps, escutcheons, connections, etc., as are necessary to complete the installation of each fixture, whether such items are listed or not.
3. Plumbing Trim: All finished exposed faucets, traps, connecting piping, stops, flush valves and other fixture trim shall be chromium-plated brass unless otherwise specified and shall be supported rigidly to fixtures and to walls with matching brackets at not more than 2'-0" center. All fastenings shall be chromium-plated brass or may be 302 stainless steel if of matching color and finish. Faucets shall be furnished as required. Vacuum breakers shall be provided as a part of the fixture trim wherever there is a possibility of back-siphoning.
4. Fixture Stops: Shut-offs for urinal and water closet flush valves shall be an integral part of the fixture or fitting; shut-offs for all other fixtures shall be loose-key, lock-shield-type. All fixture stops shall be angle- or straight-type adapted for each particular location and shall be located immediately adjacent to the fixture. Use threaded adaptors when used in conjunction with copper tube work.
5. All exposed screws or fasteners for plumbing fixtures and faucets shall be vandalproof. Contractor shall take care to coordinate this item with his suppliers prior to Shop Drawings submittal.
6. Aerators, where required for sinks and lavatories shall be vandalproof

1.2 QUALITY ASSURANCE

A. Meet the requirements of the following:

1. State Plumbing Code.
2. State Department of Housing, Buildings and Construction.

B. Material Standards

1. ANSI/ASME A112.19.2-90: Vitreous China Plumbing Fixtures.
2. ANSI/ASME A112.19.3-87: Stainless Steel Plumbing Fixtures (Designed for Residential Use).
3. ANSI/ASME A112.19.5-79: Trim for Water Closet Bowls, Tanks, and Urinals.
4. ANSI/ASSE 1016-90: Performance Requirements for Thermostatic, Pressure Balancing and Combination Control Valves for Bathing Facilities.

C. ANSI/ASSE 1025-78: Performance Requirements for Diverters for Plumbing Faucets with Hose Spray, Anti-Siphon-Type, Residential Applications.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fixtures.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For flushometer valves and electronic sensors to include in operation and maintenance manuals.
2. For lavatories and faucets to include in operation and maintenance manuals.
   a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following: Servicing and adjustments of automatic faucets.
3. For sinks to include in maintenance manuals.
4. For shower faucets to include in maintenance manuals.
5. For pressure water coolers to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no less than one of each type.
2. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
3. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
4. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no less than 1 of each.

PART 2 - PRODUCTS

2.1 MATERIALS - GENERAL

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Plumbing Faucets: Chicago Faucet, American Standard, Kohler, Symmons, Speakman, and Moen.
2. Flush Valves: Sloan, Moen and Zurn.
3. Vitreous China Plumbing Fixtures: American Standard, Kohler, Gerber.
4. Service Basins: Fiat, Stern and Williams, Mustee, Zurn and Creative Industries.
5. Closet Seats: Church, Sperzel, Bemis, Beneke, and Centoco.
6. Stainless Steel Sinks: Elkay, Just, Metcraft, and Southern Kitchens.
7. Electric Water Coolers: Elkay, Haws, Oasis, and Halsey-Taylor.
8. Carriers: Josam, Smith, Wade, Watts, Zurn or Mifab.

B. Plumbing Fixtures – General: Constructed or equipped with anti-siphon devices to prevent siphoning waste material into potable water supply system.

C. Escutcheons and Plates: Conceal all holes where pipes pass through walls, floors or ceilings; use plates or escutcheons.

D. Piping Exposed in Finished Areas (including fittings and trim): Chromium-plated or nickel-plated brass with polished bright surface.

E. Trim for Lavatories and Sinks: Provide with renewable cartridges.

F. Vitreous Caps: Provide for water closet bolts.

G. Sealant: Silicone-type. See Division 07 Section “Joint Sealants”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet

1. Installation:

a. Install level and plumb according to roughing-in drawings.
b. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

2. Support Installation:

a. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
b. Use carrier supports with waste-fitting assembly and seal.
c. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.

3. Flushometer-Valve Installation:

a. Install flushometer-valve, water-supply fitting on each supply to each water closet.
b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
c. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
d. Install actuators in locations that are easy for people with disabilities to reach.
e. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

4. Install toilet seats on water closets.

B. Urinal

1. Installation:

a. Install urinals level and plumb according to roughing-in drawings.
b. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.

c. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
d. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
e. Install trap-seal liquid in waterless urinals.

2. Support Installation:

a. Install supports, affixed to building substrate, for wall-hung urinals.
b. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
c. Use carriers without waste fitting for urinals with tubular waste piping.
d. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

3. Flushometer-Valve Installation:

a. Install flushometer-valve water-supply fitting on each supply to each urinal.
b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
c. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
d. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

C. Lavatories

1. Install lavatories level and plumb according to roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted lavatories.

a. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

3. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
4. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
5. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

D. Sinks

1. Install sinks level and plumb according to roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-hung sinks.

a. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

3. Set floor-mounted sinks in leveling bed of cement grout.
4. Install water-supply piping with stop on each supply to each sink faucet.

a. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
b. Install stops in locations where they can be easily reached for operation.

5. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
6. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

E. Electric Water Coolers

1. Install electric water cooler level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
2. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
3. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.
4. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
5. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants. “Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixture with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to fixtures, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust fixture and controls. Replace damaged and malfunctioning fixture

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean fixture and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 40 00

SECTION 23 00 00

HVAC GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general requirements applicable to all HVAC work.

B. Provide complete and fully operational HVAC systems controlled as indicated.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data: As indicated in other Division 23 Sections.
2. Shop Drawings: As indicated in other Division 23 Sections.

B. Informational Submittals:

1. Coordination Drawings: Plans, elevations, sections, and details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

    a. Building roofs, walls, and floors.
    b. Building structural components to which equipment, piping, ductwork, cables, and conduit will be attached.
    c. Suspended ceiling components.
    d. HVAC equipment, piping, ductwork, and controls.
    e. Size and location of access doors and panels installed in walls and inaccessible ceilings for products installed behind walls and requiring access.
    f. Items penetrating finished ceiling including the following:

1) Luminaires.
2) Air outlets and inlets.
3) Ceiling-mounted devices including speakers, sensors, and WI-FI antennae.
4) Sprinklers.
5) Service access panels.

C. Closeout Submittals:

1. Operation and Maintenance Data: For HVAC systems and equipment to include in emergency, operation, and maintenance manuals. Provide data in pdf format on CD, DVD, or USB media.
2. Warranty documentation:
3. Record documentation:
4. Testing, adjusting and balancing report.
5. Start reports for all equipment.
6. Field reports, including ductwork leakage testing and piping pressure testing.
7. Valve tag charts.
8. Subcontractor contact list including name, phone number and email contact information.
9. Maintenance Items: Provide items specified in other Division 23 Sections packaged with protective covering for storage and identified with labels describing contents.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Where feasible, arrange for product delivery when construction has progressed enough to allow the products to be installed in their final locations. If lieu of the above, store products protected from weather and physical damage.

B. Deliver pipes and tubes with factory applied end caps. Maintain end caps through shipping, storage and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture into pipe.

C. Do not allow any materials or equipment to be stored in standing water or exposed to the elements.

D. Handle products carefully to prevent damage. Do not install damaged items; replace them with new items. If approved by the Engineer, items with minor damage may be repaired and installed.

1.5 COORDINATION

A. Arrange for pipe spaces, chases, and openings in building structure during progress of construction, to allow for HVAC installation.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

D. Existing Utilities: Do not interrupt utilities serving facilities occupied or partially occupied unless specifically allowed under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner at least seven days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions and method of interruptions in detail.
2. Do not proceed with proposed utility interruptions without Owner’s permission.
3. Utilization of the permanently installed HVAC systems to condition or pressurize the construction area is not allowed without prior specific written authorization from the Owner listing which equipment may be operated under what limiting conditions. Provide written agreement to compensate the Owner for utility usage.

E. New Equipment:

1. All equipment items are to remain disabled and off unless TAB personnel are on-site actively testing the equipment.
2. Utilization of the permanently installed HVAC systems to condition or pressurize the construction area is not allowed without prior specific written authorization from the Owner listing which equipment may be operated under what limiting conditions. Provide written agreement to compensate the Owner for utility usage.

F. Coordinate new installations with existing installations which will remain in place and either be reutilized or be abandoned in place. Provide transitions and fittings in ductwork and piping as well as extra lengths of ductwork and piping as required to route around existing installations. Illustrate all such ductwork fittings on the sheet metal shop drawing submittal. Existing installations include plumbing, piping, electrical and other building system components including, but not limited to, roof drain piping, sanitary piping, plumbing piping, fire protection piping and heads, heating and cooling water piping, condensate drains, steam and condensate piping, conduit, cable tray, electrical pull boxes, projectors, booms, etc.

G. Provide temporary connections to maintain existing systems in service during construction.

H. Provide the Owner a schedule prior to the start of demolition with a phased selected demolition identified by system and by floor. Identify required outages on the schedule and any temporary measures required to maintain existing systems in service.

I. Coordinate HVAC demolition with all aspects of demolition and temporary construction (including dust barriers) by other trades.

J. The Drawings indicate the general arrangement and scope of the systems and shall be followed insofar as possible. If deviations from the layout are necessitated by field conditions, submit detailed layouts of the proposed departures in writing to the Engineer for approval before proceeding with the work.

K. The Drawings are schematic and are not intended to show every vertical and horizontal offset that may be necessary to complete the system or clear obstructions or the work of the other contractors. Contractors shall anticipate during bidding that additional offsets may be required and include same in their proposals.

L. The Drawings and Specifications are complementary. Items appearing in the Specifications may not be indicated on the Drawings or vice-versa, but all shall be considered as part of the Contract and must be executed by the Contractor the same as though indicated by both. Clarify conflicting statements with the Engineer prior to submitting a bid.

M. Measurements: Make your own measurements on site and be responsible for correct sizes. Coordinate this work with all other branches and trades in such a manner as to cause a minimum of conflict or delay. Coordinate your work in advance with all other trades and report immediately difficulties anticipated; propose solutions to resolve potential difficulties.

N. Clearances: Install items to maintain maximum headroom and clearance around equipment. When space or headroom appear inadequate, notify the Engineer prior to proceeding with the installation. No claims for additional compensation due to failure on the part of the Contractor or his subcontractor to comply with this requirement will be approved.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the listed manufacturers. Where a specific manufacturer is listed on the Drawings, consider it as the Basis-of-Design.

2.2 ELECTRICAL REQUIREMENTS

A. Electrical Characteristics for HVAC Equipment: Equipment with higher electrical power requirements may be furnished provided that such proposed equipment is approved in writing and that connecting electrical supply, wiring, overcurrent protection devices, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

2.3 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, non-gaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine work area and rough-in work before beginning installation.

B. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Plan Work beforehand.

B. Request explanation from the Engineer if the intent of the Drawings or Specifications is not clear.

3.3 INSTALLATION

A. Install mechanical items in accordance with the Specifications and manufacturer’s installation instructions.

3.4 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project site.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches horizontally larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi 28-day compressive-strength concrete and reinforcement.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Metal channel (strut) products in accordance with Metal Framing Manufacturers Association standards may be used for metal framing and anchorages.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting or weakening wood members.

C. Attach to substrates as required to support applied loads.

3.7 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will contact grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth and level bearing surfaces for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.8 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom if specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Maintain manufacturer’s recommended service clearances. Maintain NFPA 70 required clearances to electrical components.

D. Connect equipment for ease of disconnecting with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment to allow space for piping installed at required slope.

3.9 CLEANING AND RESTORATION

A. Repair damage resulting from the execution of the Work.

B. Leave the work area in broom clean condition or better at the end of each day.

C. Thoroughly clean the work area at the completion of construction.

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect mechanical equipment components, assemblies, and installations, including connections.

B. Non-Conforming Work: Items will be considered defective if they do not pass tests and inspections.

C. Reports: Prepare test and inspection reports for informational submittals.

3.11 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.12 STARTUP

A. Manufacturer's Field Service: Engage a factory-authorized service representative to startup mechanical equipment according to manufacturer’s instructions.

3.13 DEMONSTRATION

A. Engage factory-authorized service representatives to train Owner's maintenance personnel to adjust, operate, and maintain equipment. Video record the training sessions and provide electronic copy to Owner.

END OF SECTION 23 00 00

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Rotor: Random-wound, squirrel cage.

E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating.

G. Insulation: Class F.

H. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. Grounding: Maintenance free, conductive micro-fiber shaft-grounding ring with a minimum of two rows of circumferential micro fibers to discharge shaft voltages away from the bearings to ground.
    a. Motors 100 HP or Less: One shaft grounding ring installed either on the drive end or non-drive end.
    b. Motors More Than 100 HP: Insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor.
    c. All Motors: Bonded from motor foot to system ground with high-frequency ground strap of flat braided, tinned copper with terminations to accommodate motor foot and system ground connections.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 ELECTRONICALLY COMMUTATED MOTORS (ECM)

A. Motor: Brushless permanent magnet DC motor.

B. Control: Integral control module to convert AC power to DC power and to generate three-phase signal to direct motor speed. Motor speed adjustment through 0-10 V DC input.

PART 3 - EXECUTION (Not Applicable)

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SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers, saddles, and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Equipment supports.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports.”

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

1.4 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated.
2. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

a. Trapeze pipe hangers.
b. Metal framing systems.

c. Fiberglass strut systems.
d. Pipe stands.
e. Equipment supports.

B. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

C. Informational Submittals:

1. Welding certificates.

D. Closeout Submittals:

1. Operation and Maintenance Data.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. SMACNA.

D. Pipe Hanger Standards: Manufacturers Standardization Society (MSS) SP-58, SP-89, and SP-69, as referenced.

E. Seismic applications listed within SMACNA that are not usable within a given structure, shall be resolved through engineered adaptations or alteration. Whenever possible these adaptations or alternations shall use SMACNA approved components, to maintain compliance and uniformity with SMACNA's engineering standards and design principles. In all cases, and prior to installation, these adaptations or alternations shall be engineered in accordance with standard engineering practices by a qualified, registered structural engineer, and shall be submitted to project structural engineer and mechanical engineer for their review and approval.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. B-line Systems, Inc; a division of Cooper Industries.
2. Carpenter & Paterson, Inc.
3. ERICO/Michigan Hanger Co.
4. Globe Pipe Hanger Products, Inc.
5. Grinnell Corp.
6. National Pipe Hanger Corporation.
7. PHD Manufacturing, Inc.

B. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

C. Saddles

1. Material Galvanized Steel, 180-degree shape, each saddle marked with insulation O.D. Standard manufacturers gauge per insulated pipe size.

D. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
2. Hanger Rods: Continuous-thread rod, washer, and nuts made of stainless steel.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufactured Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Unistrut Corporation; Atkore Int.
    b. Cooper B-Line, Inc.
    c. Flex-Strut Inc.
    d. Thomas & Betts Corporation.
    e. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.

4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Galvanized by electroplating or hot-dipping.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

   a. Anvil International; a subsidiary of Mueller Water Products Inc.
   b. ERICO International Corporation.
   c. PHD Manufacturing, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

2.5 FIBERGLASS STRUT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Power-Strut; Atkore Int.
2. Champion Fiberglass, Inc.
3. Cooper B-Line, Inc.
4. SEASAFE, INC.; a Gibraltar Industries Company.

B. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.

1. Channels: Continuous slotted fiberglass channel with inturned lips.
2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.6 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Carpenter & Paterson, Inc.
2. ERICO International Corporation.
3. National Pipe Hanger Corporation.
4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic or stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating Below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match outside diameter of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers, fiberglass pipe hangers, fiberglass strut systems, and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

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SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product.
2. Samples: For color, letter style, and graphic representation required for each identification material and device.
3. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
4. Valve numbering scheme.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass: 0.032-inch, stainless steel: 0.025-inch, aluminum: 0.032-inch, or anodized aluminum: 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

END OF SECTION 23 05 53

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing air systems.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

A. Action Submittals:

1. Certified TAB reports.

B. Informational Submittals:

1. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
2. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
3. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

1.4 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB contractor and certified by AABC or NEBB as a TAB technician.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard AABC or NEBB TAB forms.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.5 COORDINATION

A. Notice: Provide at least seven days' notice before each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.6 HVAC CONTRACTOR RESPONSIBILITIES

A. Provide TAB agency one complete set of contract documents, change orders, and approved submittals in digital pdf format.

B. Control contractor shall provide required BAS hardware, software, personnel, and assistance to TAB agency as required for TAB agency to balance the systems. Control contractor shall also provide trending reports as needed to demonstrate that systems are complete.

C. Coordinate meetings and assistance from suppliers and contractors as required by TAB agency.

D. Provide additional valves, dampers, sheaves and belts as required by TAB agency.

E. Provide access to all dampers, valves, test ports, nameplates, and other appurtenances as required by TAB agency.

F. Remove and replace or repair insulation as needed to provide access for the TAB work.

G. Have the HVAC systems at complete operational readiness before TAB begins.

H. Promptly correct deficiencies identified during TAB.

I. Maintain a construction schedule that allows the TAB agency to complete work prior to occupancy.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC systems and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenums are sealed (and fire-stopped if required).

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that might cause reduced capacities.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment under actual installed conditions. Use tables and charts in AMCA 201, "Fans and Systems" or in SMACNA "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, clean filters are installed, and equipment with functioning controls is ready for operation.

J. Examine terminal units, verifying that they are accessible and that their controls are connected, configured by the control contractor, and functioning.

K. Examine all equipment items to verify correct piping arrangements.

L. Examine heat-transfer coils for correct piping connections and for clean and properly-spaced fins.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for each equipment item.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. General:

a. Electrical power wiring is complete.
b. Control systems are operational.
c. Access is provided to balancing and control devices.
d. Variable frequency drive start-up procedures are complete.
e. Safety devices are operational and indicating normal status.

2. Air Side:

a. Ductwork is complete with air terminals installed.
b. Balance, fire, and smoke dampers are open and operational.
c. Control dampers are in their normal (fail) positions.
d. Equipment and duct access doors are securely closed.
e. Clean filters are installed.
f. Fans are operating and rotating in correct directions.
g. Fan vibration levels are within tolerance limits.

h. Building envelope is complete, and exterior windows and doors are closed.

3. Hydronics:

a. Piping is complete with all terminal units installed.
b. Systems are flushed, filled, and purged of free air.
c. Strainers are clean, and startup strainer screens are removed.
d. Water treatment is complete.
e. Isolation and balance valves are open and operational. Drain valves are closed.
f. Control valves are in their normal (fail) positions.
g. Pumps are operating and rotating in correct directions.
h. Pump vibration levels are within tolerance limits.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC "National Standards for Total System Balance" or NEBB "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
2. Install new insulation where insulation is removed for TAB to match removed materials. Restore insulation, coverings, vapor barrier, and finish.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control devices, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of system "as-built" duct layouts with all components identified.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

E. Verify that motor starters are equipped with properly sized thermal protection.

F. Check condensate drains for proper connections and function.

G. Check for proper sealing of air-handling-unit components.

3.5 PROCEDURES FOR CONSTANT-VOLUME AND VARIABLE-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow as follows:

a. Set outdoor air, return air, and relief air dampers for proper positions that simulate minimum outdoor air conditions.
b. Where conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
c. Where conditions are not suitable for duct Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Where sufficient space is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow. Measure fan static pressures as follows:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the discharge flexible connection.
c. Measure inlet static pressure of single-inlet fan at the fan inlet or through the inlet flexible connection.
d. Measure inlet static pressure of double-inlet fan through the wall of the plenum that houses the fan or through the inlet flexible connections.

3. Measure static pressure across each component that makes up the air-handling unit, rooftop unit, or other air-handling equipment. Report the cleanliness status of filters and the time static pressures are measured. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
4. Adjust fan speed higher or lower than indicated speed as needed to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for ducts to indicated airflows within specified tolerances.

1. Measure airflows of branch ducts.
2. Adjust branch duct balance dampers for specified airflows.
3. Re-measure each branch duct after all have been adjusted.

C. Adjust air outlets and inlets for each space to indicated airflows.

1. Adjust each outlet in same room or space to indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.
3. Measure airflows at all inlets and outlets.
4. Adjust each inlet and outlet for specified airflow.
5. Re-measure each inlet and outlet after all have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm minimum outdoor air, return air, and relief air flow rates are within design tolerances. Readjust as necessary.
2. Re-measure and confirm total airflow is within design tolerance.
3. Re-measure all final fan operating data. Include fan speeds, motor voltages, motor amperages, and static profiles.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation; adjust if necessary. Measure and record all operating data.
6. Record final performance data.

3.6 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Other Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.7 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into a separate section for each tested and balanced system. Provide a final report that is a complete record of the HVAC system performance, including conditions of operation, any outstanding items, and any deviations found during the testing and balancing process. The final report is to provide a reference of actual operating conditions for the owner and operations personnel. All measurements and test results that appear in the report must be made on site and dated by the responsible technician or test and balance engineer.

B. As a minimum the report shall include the following information:

1. Title page, including:

    a. TAB company name, address, and telephone number.
    b. Project name, client, identification number, and location.
    c. Project architectural firm, address, and telephone number.
    d. Project HVAC engineering firm, address, and telephone number.
    e. Project HVAC contracting firm, address, and telephone number.
    f. TAB certification statement.
    g. Test and balance engineer name, signature, and certification number.
    h. Report date.

2. Table of contents.
3. TAB national performance guarantee.
4. Report summary, including:

    a. List of items that do not meet specified tolerances.
    b. Information that may be considered in resolving deficiencies.

5. Instrument list, including:

    a. Type.
    b. Manufacturer.
    c. Model.
    d. Serial number.
    e. Calibration date.

C. TAB test data for all systems included in the Work.

3.8 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

    a. Measure airflow of at least 10 percent of air outlets.
    b. Measure room temperature at each thermostat or temperature sensor. Compare the reading to the set point.

c. Verify that balancing devices are marked with final balance positions.
d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner's Representative.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner's Representative.
3. Owner's Representative shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to 10 percent of the total measurements recorded.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and adjust. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's payment.

D. Prepare test and inspection reports.

END OF SECTION 23 05 93

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SECTION 23 07 13

HVAC DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes duct insulation and appurtenances.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Protection: Do not permit mineral fiber insulation to get wet. Mineral fiber insulation that is or has been wet shall be removed from the project site.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with duct Installer for duct insulation application. Establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Aeroflex USA, Inc.
    b. Armacell LLC.
    c. K-Flex USA.

2. Properties:

    a. Maximum Operating Temperature: 180 deg F.
    b. Minimum Operating Temperature: -70 deg F.
    c. Maximum Thermal Conductivity at 75 deg F Mean Temperature: Thickness 1 Inch or Less: 0.245 Btu-in/hr-ft^2-deg F.
    d. Maximum Water Vapor Permeability Thickness 1 Inch or Less: 0.05 perm-inches.
    e. Maximum Water Absorption by Volume: 0.2%.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin in a flexible blanket. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. CertainTeed Corp.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Atmosphere Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; SOFTR Duct Wrap FRK.

2. Properties:

    a. Maximum Operating Temperature: 250 deg F.

b. Maximum Compressed Thermal Conductivity at 75 deg F Mean Temperature:

1) Density 0.75 PCF: 0.29 Btu-in/hr-ft^2-deg F.
2) Density 1.0 PCF: 0.27 Btu-in/hr-ft^2-deg F.
3) Density 1.5 PCF: 0.24 Btu-in/hr-ft^2-deg F.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. For indoor applications, adhesives shall have VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

B. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation in accordance with manufacturers' instructions.

B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

C. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system.

D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Keep insulation materials dry during application and finishing. Mineral fiber insulation that is or has been wet shall be removed from the job site.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket or Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to all surfaces of ducts, fittings, and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches on center
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches on center each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not over compress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with outward-clinching staples, 1 inch on center Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches on center.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. For board insulation, groove and score insulation to fit to outside and inside radii of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches on center.

3.7 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in painting specifications.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

    a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.8 DUCT INSULATION THERMAL RESISTANCE (R VALUE) SCHEDULE

A. Space types are as defined in ASHRAE 90.1-2019.

1. Exterior ducts are in unenclosed spaces and include those outdoors, in outdoor air plenums, in attics above insulated ceilings, in parking garages, or in crawl spaces.
2. Ducts in unconditioned spaces include those in enclosed indoor spaces that are not heated, cooled, or semiheated.
3. Buried ducts are those enclosed in earth or concrete below ground.
4. Ducts in indirectly conditioned spaces including those in enclosed return air plenums, spaces above ceilings, and non-cooled mechanical or electrical rooms.
5. Ducts in conditioned spaces include those in enclosed spaces that have:
    a. Equipment sensible cooling capacities at least 3.4 Btu/hr/sf, or
    b. Equipment heating capacities at least those indicated in ASHRAE 90.1 Table 3.2.
6. Ducts in semiheated spaces include those in enclosed spaces that have equipment heating capacities at least 3.4 Btu/hr/sf but less than those indicated in ASHRAE 90.1 Table 3.2.

B. Supply Air, Return Air, or Mixed Air Ducts:

1. Exterior Ducts:

    a. Climate Zones 0, 1, 2, 3, 4: R-8.
    b. Watertight external jacket completely enclosing external duct insulation on ducts installed outdoors (other than preinsulated ducts).

2. Ducts in Unconditioned Spaces, in Semiheated Spaces, or Buried:

    a. Climate Zones 0, 1, 2, 3, 4: R-6.

3. Ducts in Indirectly Conditioned Spaces:

    a. Climate Zones 0, 1, 2, 3, 4: R-2.
    b. Return Air Ducts: No insulation required.

4. Ducts in Conditioned Spaces:

    a. Climate Zones 0, 1, 2, 3, 4: R-2.
    b. Supply Air Ducts: Double-wall ducts; no additional insulation required.
    c. Return Ducts: No insulation required.

C. Relief Air Ducts: No insulation required.

D. Exhaust Air Ducts (Other Than Ducts for High-Temperature or Grease-Laden Exhaust):

1. Ducts in Unconditioned Spaces, in Semiheated Spaces, or Buried: No insulation required unless indicated otherwise.
2. Ducts in Indirectly Conditioned Spaces: No insulation required.
3. Ducts in Conditioned Spaces: No insulation required.

3.9 DUCT INSULATION THICKNESS SCHEDULE

A. R-2:

1. Flexible Elastomeric: 1/2 inch thick.
2. Mineral-Fiber Blanket: 1-1/2 inch thick and 0.75-lb/cu. ft. nominal density.
3. Mineral-Fiber Blanket: 1-1/2 inch thick and 1-lb/cu. ft. nominal density.
4. Mineral-Fiber Blanket: 1 inch thick and 1.5-lb/cu. ft. nominal density.

B. R-6:

1. Flexible Elastomeric: 2 inches thick.
2. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
3. Mineral-Fiber Blanket: 2 inches thick and 1-lb/cu. ft. nominal density.
4. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

C. R-8:

1. Flexible Elastomeric: 2-1/2 inches thick (ducts located outdoors only).
2. Mineral-Fiber Blanket: 2-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
3. Mineral-Fiber Blanket: 2-1/2 inches thick and 1-lb/cu. ft. nominal density.
4. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

D. R-12:

1. Flexible Elastomeric: 3-1/2 inches thick (ducts located outdoors only).
2. Mineral-Fiber Blanket: 3-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
3. Mineral-Fiber Blanket: 3-1/2 inches thick and 1-lb/cu. ft. nominal density.
4. Mineral-Fiber Blanket: 3 inches thick and 1.5-lb/cu. ft. nominal density.

E. Additional Requirements or Restrictions:

1. Flexible elastomeric insulation in thicknesses greater than 2 inches is not permitted indoors.
2. Mineral fiber insulation on ducts located outdoors must have a waterproof PVC or metal jacket.

END OF SECTION 23 07 13

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating HVAC piping systems.

1.2 SUBMITTALS

A. Action Submittals

1. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Protection: Do not permit mineral fiber or calcium silicate insulation to get wet. Mineral fiber or calcium silicate insulation that is or has been wet shall be removed from the project site.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping Installer for piping insulation application.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Aeroflex USA, Inc.
    b. Armacell LLC.
    c. K-Flex USA.

2. Properties:

    a. Maximum Operating Temperature: 180 deg F.
    b. Minimum Operating Temperature: -70 deg F.
    c. Maximum Thermal Conductivity at 75 deg F Mean Temperature: Thickness 1 Inch or Less: 0.245 Btu-in/hr-ft^2-deg F.
    d. Maximum Water Vapor Permeability Thickness 1 Inch or Less: 0.05 perm-inches.
    e. Maximum Water Absorption by Volume: 0.2%.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.

2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. All-Service Jacket (ASJ): White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I. Maximum water vapor permeance 0.02 perms.
2. All-Service Jacket – Self-Sealing Lap (ASJ-SSL): ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I. Maximum water vapor permeance 0.02 perms.
3. Foil-Scrim Kraft (FSK) Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II. Maximum water vapor permeance 0.02 perms.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Adhesive as recommended by jacket material manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

   a. Johns Manville; Ceel-Co or Zeston.
   b. P.I.C. Plastics, Inc.; FG Series.
   c. Proto Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Color: White unless indicated otherwise.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

C. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

D. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

E. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with epoxy primer 5 mils thick and epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation in accordance with manufacturers' instructions.

B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system.

D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

H. Keep insulation materials dry during application and finishing. Mineral fiber or calcium silicate insulation that is or has been wet shall be removed from the job site.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical.

K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches on center.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches on center.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation to less than 75 percent of its nominal thickness.

O. Repair joint separations and cracking due to thermal movement.

P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in firestopping section.

D. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in firestopping section.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is more. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is more. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is more.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover

assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches on center and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped along length of roll with 2-inch-overlap seal. Use adhesive on the lap seal. Visually inspect lap seal for "fish mouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.8 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as indicated. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Condensate or Equipment Drain Water Below 60 Deg F, or Makeup Water:

1. NPS 1-1/4 or Smaller: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1/2 inch thick.

2. NPS 1-1/2 or Larger: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.

B. Refrigerant Suction:

1. NPS 3/4 or Smaller: Insulation shall be the following:

a. Flexible Elastomeric: 1/2 inch thick.

2. NPS 1 to NPS 6: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

3. NPS 8 or Larger: Insulation shall be the following:

a. Flexible Elastomeric: 1-1/2 inches thick.

C. Refrigerant Hot-Gas:

1. NPS 1-1/4 or Smaller: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

2. NPS 1-1/2 or Larger: Insulation shall be the following:

a. Flexible Elastomeric: 1-1/2 inches thick.

3.10 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction:

1. NPS 3/4 or Smaller: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

2. NPS 1 to NPS 6: Insulation shall be the following:

a. Flexible Elastomeric: 1-1/2 inches thick.

3. NPS 8 or Larger: Insulation shall be the following:

a. Flexible Elastomeric: 2-1/2 inches thick.

B. Refrigerant Hot-Gas:

1. NPS 1-1/4 or Smaller: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

2. NPS 1-1/2 or Larger: Insulation shall be the following:

a. Flexible Elastomeric: 2-1/2 inches thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed: None.

D. Piping, Exposed:
1. PVC, Color-Coded by System: 20 mils thick.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
1. PVC, Color-Coded by System: 30 mils thick.

D. Piping, Exposed:

1. PVC: 30 mils thick.

END OF SECTION 23 07 19

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SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.2 DEFINITIONS

A. ASC: Application Specific Controller

B. ATC: Automatic Temperature Control

C. BAS: Building Automation System

D. BC: Building Controller

E. BLCN: Building Level Communication Network

F. CAV: Constant Air Volume

G. CPC: Custom Programmable Controller

H. DDC: Direct Digital Control

I. ELCN: Enterprise Level Communication Network

J. EMS: Energy Management System

K. HOA: Hand-Off-Auto

L. I/O: Input/Output

M. MS/TP: Master Slave/Token Passing

N. OWS: Operator Workstation

O. PC: Personal Computer

P. PICCV: Pressure Independent Characterized Control Valve

Q. PID: Proportional plus Integral plus Derivative

R. RTD: Resistance Temperature Detector

S. SNVT: Standard Network Variable Type (for LonMark® controllers)

T. VAV: Variable Air Volume

1.3 SCOPE

A. Provide all necessary hardware, software and labor (design, programming, start-up, validation, acceptance, technical support, etc.) to provide a complete Building Automation System (BAS) to include all Automatic Temperature Controls (ATC) and Energy Management System (EMS) functions as specified herein and shown on the associated project drawings.

B. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate the ANSI/ASHRAE Standard 135-2001 (BACnet) and/or ANSI/EIA Standard 709.1-A-1999 (LonWorks®) communications protocols in an open, interoperable system.

C. The system shall be an electronic/electric system utilizing direct digital controllers (DDC) for all control processing. All sensors shall be electronic and all actuation devices shall be electronic unless indicated otherwise.

1.4 GENERAL SYSTEM DESCRIPTION

A. The BAS shall consist of central Servers and Routers, an Operator Workstation to provide access to the graphical operator interface software, stand-alone Direct Digital Control (DDC) panels, and associated sensors and controlled devices. DDC panels shall include Building Controllers (BC), Custom Programmable Controllers (CPC) and Application Specific Controllers (ASC). A portable Operator's Terminal (laptop computer) shall also be provided for system access. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of workstations, DDC panels, sensors, actuators, etc.

B. The BAS shall be a complete system designed for use on Intranets and the Internet. Servers and building controllers (BC) shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure within the facility. The Contractor shall be responsible for coordination with the Owner's IT staff to ensure that the BAS will perform in the Owner's environment without disruption to any other activities taking place on the infrastructure.

C. The system architectural design shall utilize a multi-tier communications network as specified herein.

D. The BAS specified herein shall be capable of integrating multiple building functions including equipment supervision and control of all field I/O points and software points, alarm management, energy management, historical data collection and archiving, data storage, report generation and graphics interaction.

E. The system architectural design shall eliminate dependence upon any single device for all alarm reporting and/or control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

F. The BAS shall interface to various building systems and equipment as specified herein.

G. Each controlled system shall have its own stand-alone DDC panel. Controllers shall not be shared across multiple controlled systems, nor shall controlled systems be split across multiple controllers. Where point counts exceed the limits of a controller, provide auxiliary input/output expansion hardware such that there is a single processor for each equipment item.
   1. For large systems, the active control points and control programming shall reside in one controller, while "monitor-only" points may reside in another separate single controller.
   2. If there are still too many active control points for the I/O capacity of a single controller, then all programming shall reside in a single controller and a second controller shall be utilized as a remote I/O board. In this scenario, sanity checking shall be required for the remote points, and the system shall shut down and alarm upon loss of communications or other invalid data from the remote controller.

H. Provide a minimum of 20% spare Input/Output (I/O) control point capacity at each DDC panel associated with a major system (i.e. boilers, chillers, air handlers). Spare points shall include a minimum of one

analog input and one analog output point, one binary input and one binary output. Universal input/output points may also be used.

1. Spare Input/Output control points shall be capable of being connected to field control/sensing devices without requiring any additional DDC hardware, to be rendered functional.

1.5 WORK INCLUDED

A. All necessary materials (including hardware and software) and labor (including design, programming, installation, start-up, validation and acceptance, training, technical support etc.) to provide a complete Building Automation System (BAS) as specified herein and shown on the associated project drawings.

B. All wiring (including sensing and control, signal, data transmission, temperature/pressure safeties, and power) except where otherwise specified, necessary for the installation of the BAS. This shall include the costs to have a qualified electrical contractor install 120 volt control power to the BAS control cabinets throughout the facility, as well as the application specific controllers and any miscellaneous power requirements. The BAS Contractor shall coordinate quantities and locations of services with the Electrical Contractor. Final connections to be made by the BAS Subcontractor.

C. Installation of all BAS components, except where otherwise specified.

D. Interfacing of the BAS to various building systems and equipment. The BAS shall communicate to the various systems through a common communications interface. Coordinate specific communications interface protocols with the equipment/system supplier/manufacturer (e.g. BACNet, etc.). Various equipment/systems shall include those listed in the drawings.

E. Cutting and patching for installation of all equipment under this contract.

F. Complete documentation, including submittals, data files, test reports, as-built documents, operating instructions, maintenance instructions and complete system warranty.

G. All necessary labor to assist the balancer in initial and final air balancing.
   1. The BAS Contractor shall coordinate set-up and calibration of all airflow measuring and control instrumentation with the balancer.

H. Furnish the following equipment to the HVAC/Plumbing Contractor for installation:
   1. Duct mounted air static pressure sensing elements/probes
   2. Airflow measuring stations
   3. All equipment (valves, dampers, actuators, drives, controllers, sensors, etc.) required to perform the sequences of operations.
   4. All others described in the specifications and drawings.

I. All necessary labor to assist the Commissioning Agent in verifying proper operation of the control system in accordance with the specified sequences of operations.
   1. The BAS Contractor shall also include labor to assist the Commissioning Agent and Owner with point-to-point verification of all specified points to ensure complete and proper operation from the end device to the operator interface. This shall include input point monitoring, output point commands/overrides and setpoint adjustments.
   2. All necessary labor to assist the Commissioning Agent in pre-functional and functional testing.
      a. The BAS Contractor shall complete pre-functional checkout sheets as requested by the engineer and commissioning agent.
      b. The BAS Contractor shall complete and document the contractors/manufacturer's startup and commissioning process prior to the commissioning agent beginning functional testing.
         1) Evidence of successful completion of point to point checkouts, controller log- ic files and tuning parameters, as well as commissioning logs shall be turned over to the Commissioning Agent prior to the start of the functional testing process.
      c. The BAS Contractor shall provide on-site assistance to the commissioning agent during the functional testing process to ensure that the testing can be completed in a timely manner.

3. The BAS Contractor shall perform full point to point checkout on all inputs and outputs integrated into the BAS system and provide this documentation to the CxA and A/E priorto functional performance testing. Point to point checkout includes, but is not limited to, the following. Coordinate with the CxA and provide any additional execution or documentation requirements as directed.
    a. Check each output (example shown for actuators)
        1) Stroke correctly (when commanded full open the actuator and assembly are driven full open, when commanded full closed the actuator and assembly are driven full closed)
        2) Document that the actual field position matches BAS reading positions
    b. Check each input (example shown for sensors)
4. With an NIST (National Institute of Standards and Testing) calibrated measurement device appropriate to the sensor type and range being referenced, measure the actual field reading and compare it to the BAS sensor measured reading. Document on a log actual measured values, BAS readings, and correction factors. This shall be completed on all inputs inclusive of factory calibrated devices and sensors provided by other trades, disciplines, or vendors.
5. Refer to all related commissioning specifications for additional commissioning requirements.

J. The BAS Contractor shall monitor the system weekly for one year to verify performance of the system. This may be done by use of the modem and remote communications.

1.6 WORK INCLUDED UNDER OTHER SECTIONS OR DIVISIONS

A. The following shall be included in the HVAC Contractor's scope of work:
1. Installation of all control and smoke dampers.
    a. Provision to adjust ductwork and penetrations for installation of dampers smaller than ductwork.
    b. Assembly of multiple section dampers with required interconnecting linkages, including shaft(s) extension through duct for external connection of damper actuators.
2. Installation of airflow and static pressure sensing/measuring stations in ducts.
3. Provision of access doors in ducts for service of control equipment.

B. The following shall be included in the Electrical Contractor's scope of work:
1. Provision and installation of all fire alarm system related components and connections, including duct mounted smoke detectors.

1.7 SUBMITTALS

A. Prior to system installation, submittal data shall be provided to the Architect and Engineer for approval. The contractor shall initiate a pre-submittal meeting with the engineer and commissioning agent to review the proposed system. The submittal contents shall include the following:
1. Damper schedule showing the following:
    a. Damper tag and location.
    b. Damper and duct sizes.
    c. Pressure drop at design flow.
    d. Quantity and model number of damper actuators.
2. Shop Drawings which shall include:
    a. Communications trunk cable schematic showing all DDC locations and all primary and secondary communications trunk data.
    b. Central system configuration complete with all peripheral devices, batteries, power supplies, diagrams, modems, etc., with interconnection diagrams.
    c. Ladder type system schematic diagrams for each controlled system detailing all controllers, control devices and equipment, including all dampers, valves, actuators, field sensing devices, input/output transducers, panel details, etc. Include specific wire and terminal number information for all devices.

d. A written Sequencing of Operation shall be included for each system. These sequences shall appear on the shop drawings and shall describe in detail how each system will be controlled. Returning a retyped copy the sequences of operation from the contract documents shall not be acceptable.
e. A schedule of all connected points, including the point naming to be used, device type and range, output type and range, software address and DDC to which they are connected.
f. Equipment lists for each system drawing, of all proposed devices and equipment.
g. Field wiring diagrams showing all power supply connections; control wire connections to remote instruments and control devices; all wire connections to motor starters. Show all wire terminal designations including terminal designations used on motor control centers.
h. Interfaces with equipment provided by other contractors/manufacturers. Clearly illustrate and define these interfaces including:
   1) System, subsystem and specific component interfaces.
   2) Normal and abnormal conditions.
   3) Specific connections including terminal numbers.

3. Data sheets and technical information for all devices. Information shall include range, units, line size ratings, power supply requirements, input and output signal descriptions, contact ratings and outline dimension drawings. Specific devices and device options shall be highlighted on data sheets showing multiple items.
4. Sketches of system graphics showing all monitored systems, data (connected and calculated) point addresses and operator notations.
5. Licensing agreement for each licensed software module (one copy to be executed by the
6. Owner prior to software delivery).
7. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE standard 135.
8. Software Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
9. ASC and CPC software programs. Include the following:
   a. Software operating and upgrade manuals.
   b. Software programs in electronic format.

B. Submit for final record:
1. As-built shop drawings of all systems, control panels and components, incorporating all field modifications made, prior to the Owner's acceptance. Include control panel ladder diagrams, and terminations identified in the same manner as the wires are tagged in the field. Include all final room numbers, and equipment tags, etc.
2. Product data sheets and manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
3. Operation and Maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   a. Maintenance manuals/instructions and lists of spare parts for each type of control device.
   b. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
   c. All system and device operation manuals/instructions for HVAC instrumentation and control system, including normal and emergency operation.
   d. Complete set of operator workstation manuals include operation manuals for the graphical user interface.
   e. Complete set of programming manuals for the central server, operator workstation, graphical user interface, BCs, CPCs, and ASCs.

1.8 QUALITY ASSURANCE

A. Electric components shall be UL listed.

B. Damper components shall comply with AMCA 500.

C. Energy management components shall comply with NEMA EMCI.

D. Enclosures shall comply with NEMA 250.

E. Electrical requirements shall meet NFPA70.

F. Installation as a part of the HVAC system shall comply with NFPA 90A.

G. Control systems shall meet the requirements of ASHRAE Standard 90.1.

H. Comply with ASHRAE 135 for DDC system components.

I. The BAS specified herein shall be the product of one manufacturer except for certain components where specified and shall be designed, installed, programmed and commissioned by experienced personnel regularly employed by the manufacturer or the manufacturer's representative. If a local representative other than a manufacturer's branch office is utilized, the representative must be certified as an Authorized Controls Integrator (ACI) by the manufacturer.

J. The systems control contractor shall have been in business a minimum of five years or have equivalent experience and have been the authorized installing contractor for the manufacturer of the system components for a minimum of two years.

K. The control system shall be engineered, programmed and supported completely by the representative's local office that must be within 75 miles of project site.

L. The supplier of the BAS shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship furnished.

M. The BAS supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the system.

N. Prototype, experimental, or "BETA-SITE" hardware or software shall not be used on this Project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.10 COORDINATION

A. Coordinate the work in this spec. section with all other trades. General provisions and mechanical systems are specified in other sections of Division 23.

B. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

C. Coordinate all HVAC equipment connections with the unit manufacturer and supplier.

D. Coordinate supply of conditioned electrical circuits for control units and operator workstation.

1.11 WARRANTY

A. In addition to warranty requirements of Division 01, The BAS shall be additionally warranted as follows:

1. The BAS shall be warranted against defects (materials and labor) for a period of 1 year (or longer as required by Division 01) commencing on the date of Owner acceptance of the system (or as specified in Division 01).
2. Owner acceptance of the system shall take place once the control system operation has been tested and accepted in accordance with the terms of this specification. Refer to the system demonstration, validation and acceptance section of this specification for more information.
3. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate validation and acceptance phase and warranty start date and period.
4. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within one business day of Owner's warranty service request, except where to do so would potentially compromise the safety of the building occupants or cause damage to the facility or equipment. Where this is the case an immediate response shall be required.
5. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor- identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. No updates or upgrades shall be installed without the Owner's written authorization.
6. The BAS contractor shall modify the programs and/or setpoints as required during the first year of systems occupancy to determine the individual systems settings, to provide accurate and reliable space temperature control at the designated setpoints.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Automated Logic-Installed by EMCOR

B. The naming of any manufacturer does not constitute acceptance of their product nor waive responsibility to comply with all requirements of this specification.

2.2 SUBSTITUTION TECHNICAL PROPOSAL

A. The entire BAS shall be furnished by a single supplier.

B. The Contractor shall, prior to the time of entering his/her bid (10 working days minimum), submit a technical proposal for the Owner’s and Engineer’s evaluation, describing the manner of compliance with this minimum performance specification and detailing any exceptions or variations from this specification.

C. Certify acceptance of all general provisions included in this specification, in writing.

D. The technical proposal shall be provided in a binder, tabbed for easy reference. All drawings included shall be reduced in size and folded to fit in the proposal.

E. Review of the submitted technical proposal shall not be construed as approval of the system and shall not relieve the system Contractor of fulfilling the requirements of the specifications in total.

F. Review the mechanical installation and electrical installation requirements with the Division 23 and Division 26 Contractors respectively. Assume complete responsibility for assuring that all installation criteria relevant to the BAS is understood by those contractors and that their bid prices reflect the design parameters.

2.3 COMMUNICATIONS SYSTEM ARCHITECTURE

A. Enterprise Level Communications Network (ELCN)
1. The ELCN shall be based upon the ISO 8802-3 Ethernet standard (IEEE 802.3), utilizing Internet Protocol (IP) communications and operate at a minimum of 10/100 Mb/sec. The installation of all Ethernet wiring, accessories, and connectors shall conform to the ISO standard
2. The preferred connection media shall be 10 Base-T, Category 5e, Unshielded Twisted Pair (UTP-8) wire. The maximum single network run shall not exceed more than 250 feet. If additional distance is needed, the use of hubs or other Ethernet media will be acceptable. However, the 'cascading' of more than 3 hubs on a single segment will not be accepted.
3. The BAS shall utilize the ELCN for communications between the servers, routers, operator workstations and building controllers.
4. The BAS Contractor shall provide their own Ethernet communications network including all necessary Ethernet hubs, switches, routers, wiring/cabling etc. required to enable ELCN communications between the BAS equipment within the building. Provide an Ethernet switch as the point of connection to the Owner's IT network to allow for BAS web access from the Owners network.
5. With written permission from the Owner and the Owner's IT staff, the BAS system may utilize the Owner's IT infrastructure within the facility for the ELCN provided the bandwidth consumption is less than 5% of the total network bandwidth. Under no circumstances, shall the Owner's network be subject to failure and/or abuse.
    a. The BAS Contractor shall be responsible for coordination with the Owner's IT staff to ensure that the BAS will perform in the Owner's environment without disruption to any other activities taking place on the infrastructure.
    b. If permission is granted to use the Owner's IT network:
        1) The Owner shall provide the IP address(es) for the control system to utilize the Owners IT infrastructure.
        2) The BAS contractor is still responsible for the communications wiring between the BAS equipment and the Owner designated connection locations. Final connections shall be coordinated with the Owner's IT staff.
        3) The BAS Contractor shall conform to the Owner's IT standards for all wiring/cabling and connection details.
6. Acceptable protocols for this communications network are as follows
    a. BACnet/IP protocol (Annex J) as defined by ANSI/ASHRAE Standard 135-2001.
        1) The system shall be a minimum conformance class 3, as identified by the standard. BACnet compatible systems that employ the use of proprietary 'gateways' will not be accepted unless otherwise noted.
7. All tools required to manage the ELCN shall be provided with the system

B. Building Level Communications Network (BLCN)
1. This communications network shall be limited to Building Controllers/Routers, Custom Programmable Controllers and Application Specific Controllers, and shall communicate bi-directionally with the ELCN.
2. The BAS shall utilize the BLCN for communications between the BCs and the CPCs/ASCs and communications between CPCs and ASCs.
3. Acceptable protocols for this communications network are as follows
    a. BACnet via Master-Slave/Token-Passing protocol (MS/TP), as acknowledged by the ANSI/ASHRAE 135 standard. The MS/TP link shall operate at a 76.8 Kbps minimum, and utilize no more than 2 repeaters in any instance.
4. All tools required to manage the BLCN shall be provided with the system.

C. Remote Communications
1. The BAS installed in this building shall be integrated into the central BAS (main library) for remote monitoring.
2. Remote offsite communications to the Building Controllers shall be provided. In the event connection to the owner's Ethernet infrastructure is not made available from outside the district, dial-up communications shall be provided to allow remote operator stations to communicate with Building Controllers on an intermittent basis via telephone lines.
3. Operators at dial-up workstations shall be able to perform all operator functions as described for workstations connected via the network.

4. An operator shall be able to access buildings by selection of any facility by its logical name. The workstation dial-up program shall store the phone numbers of each remote site, so the user shall not be required to remember or manually dial telephone numbers.
5. Dial-up communications shall make use of industry standard 56K modems with auto ranging and voice grade telephone lines. Each standalone DDC panel may have its own modem, or a group of Standalone DDC panels may share a modem.
6. Cost of the phone line installation is the responsibility of the Owner.

2.4 SERVERS

A. Central servers shall provide the following minimum functions:
1. A central point of access to all data distributed throughout the system. When logged onto the server, the operator will be able to interact with any of the DDCs on the network, within their access privileges. User shall not be required to know the individual addresses of the building controllers in order to gain access to the data contained within those controllers.
2. Master clock services and time synchronization throughout the network.
3. Master global scheduling of all data throughout the network. The global schedules shall then be distributed to the appropriate local control panels throughout the network.
4. Master security functions including password definition and maintenance.
5. Central alarm management including routing of alarms to workstations, printers, pagers, or email.
6. Implementation of global control functions, such as demand limiting, on data located anywhere in the network.
7. An archive location for all data collected by the building controllers such as trends, alarm and event histories, and transaction logs.

B. Access to all information on the server shall be through the same user interface used to access the DDC panels.

C. Servers shall communicate on the ELCN.

D. Server functionality may be performed by a master BC, distributed amongst the BCs located throughout the ELCN, included as part of an operator workstation, or provided on a separate hardware platform. If a separate hardware platform is used, it shall meet or exceed the hardware specifications for an operator workstation.

2.5 OPERATOR WORKSTATIONS

A. Operator workstations shall provide user access to the operator interface sofware.

B. Operator workstations shall communicate on the ELCN.

C. System shall be new. Refurbished systems are not acceptable.

D. Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Acer
2. Dell
3. Gateway
4. Hewlett Packard

E. The hardware platform for servers and operator workstations shall meet or exceed the following specifications:
1. Processor: Intel® Pentium® 4 with 2 GHz processor
2. Installed Memory: 1 GB SDRAM, 400 MHz
3. Hard Drive: 50 GB, 7200 rpm
4. Optical Drive: Read/Write CD-ROM drive
5. Monitor/Display: LCD flat panel display, 17” diagonal screen, 1280 x 1024 resolution, and 0.28 dot pitch

6. Network Interface: Internal Ethernet 10/100
7. Modem: 56Kbps
8. Port Connectors: (6) USB 2.0, (1) Video, (1) Parallel, (2) PS/2, (1) Audio
9. Input Devices: Keyboard, Wheel Mouse
10. Include all parts required for BAS along with all cables
11. Printer: Color (Inkjet or Laser) with all required cables
    a. Print speed: 12 ppm (black)

F. Installed software shall include:
1. Current version of Microsoft® Windows operating system
2. Current version of Microsoft® Office Standard Edition

2.6 PORTABLE OPERATOR'S TERMINAL

A. A portable operator's terminal shall be furnished by the BAS contractor.

B. The portable operator's terminal shall include all necessary software, tools and cables to directly connect to all BCs, CPCs and ASCs to accomplish the following:
1. Upload, download and modification of all programs within the controller.
2. Monitor, command and override of all input, output and data points, including setup parameters, residing within the controller.
3. Modification of all time schedules located within the controller.

C. For controllers mounted in inaccessible locations, such as VAV box controllers mounted above the ceiling, access shall be obtained through a port at the local room thermostat.

D. The portable operator's terminal shall also connect to the Owner's IT infrastructure and access the BAS through the ELCN in the same manner as a standard operator workstation.

E. System shall be new. Refurbished systems are not acceptable

F. Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Acer
2. Dell
3. Gateway
4. Hewlett Packard
5. Toshiba

G. The hardware platform for a portable operators terminal shall meet or exceed the following specifications:
1. Processor: Intel® Pentium® 4 processor with 1.3 GHz processor
2. Installed Memory: 512 MB SDRAM, expandable to 1 GB
3. Hard Drive: 30 GB, 5400 rpm
4. Optical Drive: 24x CD-ROM drive
5. Display: 14" XGA active matrix, with 1024x768 pixel resolution, and 16.7M colors
6. Network Interface: Internal Ethernet 10/100
7. Port Connectors: (2) USB 2.0, (1) Video, (1) Audio
8. Include all parts required for BAS along with all cables

H. Installed software shall include:
1. Current version of Microsoft® Windows operating system
2. Current version of Microsoft® Office Standard Edition

2.7 GRAPHICAL OPERATOR INTERFACE

A. The graphical operator interface software may reside on a central server, an operator workstation or within a BC, and shall be accessed through an operator workstation or portable operators terminal.

B. The operator interface shall be a graphical user interface and shall include the following basic utility features and application programs.
   1. Display
      a. The Operator Interface shall minimize operator training through the use of English language prompting, English language point identification, and industry standard PC application software. The operator interface shall minimize the use of a typewriter style keyboard through the use of a mouse or similar pointing device, and "point and click" approach to menu selection. Users shall be able to start and stop equipment or change setpoints from graphical displays through the use of a mouse or similar pointing device.
      b. At the option of the user, the Operator Interface shall provide consistent graphical or text-based displays of all system point and application data described in this specification. Point identification, engineering units, status indication, and application naming conventions shall be the same at all workstations.
      c. The Operator Interface shall provide the ability to simultaneously view several different types of system displays in overlapping windows to speed building analysis. For example, the interface shall provide the ability to simultaneously display a graphic depicting an air handling unit, while displaying the trend graph of several associated space temperatures to allow the user to analyze system performance.
   2. Security
      a. Multiple-level password access protection shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as he deems appropriate for each user, based upon an assigned password.
      b. Passwords shall be exactly the same for all operator devices, including portable or panel-mounted network terminals. Any additions or changes made to password definition shall automatically cause passwords at all DDC panels on a network to be updated and downloaded to minimize the task of maintaining system security. Users shall not be required to update passwords for DDC panels individually.
      c. A minimum of five levels of access shall be supported
         1) Level 1 = Data access and Display
         2) Level 2 = Operator overrides
         3) Level 3 = Database Modification
         4) Level 4 = Database Generation
         5) Level 5 = Password Add/Modification
      d. A minimum of 200 passwords shall be supported.
      e. Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device, including portable or panel mounted devices, shall be limited to only those items defined for the access level of the password used to log-on.
      f. User-definable, automatic log-off timers from 1 to 60 minutes shall be provided to prevent operators from remaining logged in inadvertently.
   3. Operator Commands
      a. The operator interface shall allow the operator to perform commands including, but not limited to, the following:
         1) Start-up or shutdown selected equipment
         2) Command and Override of all analog and digital outputs
         3) Adjust setpoints
         4) Add/Modify/Delete time programming
         5) Enable/Disable process execution
         6) Lock/Unlock alarm reporting for each point
         7) Enable/Disable Totalization for each point
         8) Enable/Disable Trending for each point
         9) Override PID Loop setpoints
         10) Enter temporary override schedules
         11) Define Holiday schedules
         12) Change time/date
         13) Enter/Modify analog alarm limits
         14) Enter/Modify analog warning limits
         15) View limits

16) Enable/Disable Demand Limiting for each meter
17) Enable/Disable Duty Cycle for each load
18) Download operating systems, databases and application programs to stand- alone DDC panels and ASCs

4. Scheduling
   a. Operator's workstation shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.
   b. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
   c. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
5. Reporting
   a. Reports shall be generated automatically or manually, and directed to computer displays, printers, or disk files. As a minimum, the system shall allow the user to easily obtain the following types of reports:
      1) A general listing of all points in the network
      2) List all points currently in alarm
      3) List of all off-line points
      4) List all points currently in override status
      5) List of all disabled points
      6) List of all points currently locked out
      7) List of all weekly schedules
      8) List of Holiday Programming
6. Alarm Handling
   a. Operator's workstation shall provide audible, visual, and printed means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the application(s) currently running. Printout of alarms shall be sent to the assigned terminal and port.
   b. System shall provide a log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment and identification of operator acknowledging alarm.
   c. Alarm messages shall be in user-definable text (English or other specified language) and shall be entered either at the operator's terminal or via remote communication.
7. Demand Limiting
   a. System shall include a demand limiting program. Load shedding shall shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system.
   b. Shedding shall include minimum of 4 priority levels of equipment shedding. All loads in a given priority level shall be shed before any loads in a higher priority level are shed. Load shedding within a given priority level shall include two methods. In one the loads shall be shed/restored in a "first off-first on" mode and in the other the loads are just shed/restored in a linear fashion.
   c. Each load shall have adjustable shed time durations and shall have the ability to have an associated comfort override input that allows the load to be restored based on an uncomfortable condition.
8. Paging
   a. Provide the means of automatic alphanumeric paging of personnel for user- defined FMS events.
   b. System shall support bothnumeric and alpha-numeric pagers, using Alphanumeric, PET, or IXO Protocol at the Owner's option.
   c. Users shall have the ability to modify the phone number or message to be displayed on the pager through the system software.
   d. System shall utilize pager schedules to send pages to the personnel that are "on- call".

e. Contractor shall be responsible for providing a modem for connection to the paging service.

C. Dynamic Color Graphic Displays:
1. Color graphic floor plan displays, and system schematics for each piece of mechanical equipment shall be provided to optimize system performance analysis and speed alarm recognition.
2. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection, or text-based commands.
3. Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention. Display value updates shall occur once a minute at a minimum.
4. Graphic generation software shall be provided to allow the user to add, modify, or delete system graphic displays.
5. The BAS contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers etc.), complete mechanical systems, (e.g. constant volume-terminal reheat, VAV, etc.) and electrical symbols.
6. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:
   a. Define symbols
   b. Position and size symbols
   c. Define background screens
   d. Define connecting lines and curves
   e. Locate, orient and size descriptive text.
   f. Define and display colors for all elements
   g. Establish correlation between symbols or text and associated system points or other displays.
7. Graphical displays can be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout, or any other logical grouping of points, which aid the operator in the analysis of the facility. To accomplish this, the user shall be able to build graphic displays that include point data from multiple DDC panels.

D. Site Specific Customizing Software
1. Software shall allow the user to modify and tailor the BAS to the specific and unique requirements of the equipment installed, the programs implemented and to staffing and operational practices. Online modification of system configuration, program parameters and database shall be provided via menu selection and keyboard entry of data into preformatted self-prompting templates. As a minimum, the following modification capability shall be provided:
2. Operator assignment capability shall include designation of operator passwords, privilege(s), starting graphic and auto sign off.
3. Peripheral assignment capability shall include assignment of segregation groups to consoles and printers, designation of backup consoles and printer.
4. System configuration/diagnostic capability shall include communications and peripheral port assignments, DDC assignments to the communications network, DDC enable/disable, assignment of command trace to points, and initiation of diagnostics.
5. System text add/change capability shall include English descriptors for graphic points, action messages for alarms, runtime and trouble condition messages.
6. Time/Schedule change capability shall include time/date set, time/occupancy schedules, holiday schedules, daylight savings time schedules and activity defined schedules. All time and calendar scheduling and schedule modification shall be accomplished in a hardware independent manner.
7. Points shall be definable as to coloration, animation, audible rate and duration, point descriptors (60 characters minimum), operator messages (480 characters minimum), printer options, alarm archival option, alarm and warning limits and engineering units.
8. Point related change capability shall include system/point enable/disable; runtime enable/disable; assignment of point to point classes/groups, analog value offset, lockout, runtime, setting a fixed input or output value, alarm values or conditions.
9. Application program change capability shall include enable/disable of BAS programs, BAS program parameter changes, assignment of comfort limits, global points, time and event initiators, time and event schedules and enable/disable time and event programs.

2.8 WEB INTERFACE

A. The BAS shall include a web-based interface that allows for a minimum of 5 simultaneous users. An operator shall be able to access all the information in the system via this interface. The web-page software shall not require a per user licensing fee or annual fee.

B. The web-based interface shall be accessible via industry standard PCs/Laptops, utilizing “off the shelf” technology, residing on the Intranet/Internet. These PCs shall not require the purchase of any additional software from the BAS manufacturer for use as a BAS workstation. Interface to the BAS from these PCs shall be accomplished via standard Web browsers.

C. Web browsers shall be a standard current version of Internet Explorer™ or Netscape Navigator™. No special vendor-supplied software shall be needed on the client computers. All information shall be viewable, real-time and updated automatically without user interaction.

D. In its entirety, the “Thin” client web application shall not be dependent upon the use of third party plug-ins (i.e. Shockwave, Flash Player, etc.).

E. Web page graphics shown on the browser shall be replicas of the BAS displays. Operators shall need no additional training to understand the information presented on the web pages when compared to what is shown on the BAS displays.

F. Values displayed on the web page shall update automatically without requiring a manual refresh of the page.

G. An operator, via the web, shall have the ability to:
1. Navigate real-time through the system
2. Change setpoints.
3. Manually command or override any input, output or value.
4. View and acknowledge active alarms
5. Create and edit building schedules
6. Trend any point or value and display graphically or in table format
7. Display a summary of overridden points
8. Create new users or user groups, assign access privileges and edit existing user access privileges

H. Access via the web browser shall utilize the same hierarchical security scheme as the BAS system. User shall be asked to log in once the browser makes connection to the web page. Once the user logs in, any and all changes that are made shall be tracked by the BAS system. The user shall be able to change only those items that the user has authority to change.

I. The Owner shall provide the IP address(es) for remote access, to the control system, via the Internet.

2.9 STAND ALONE BUILDING CONTROLLERS (BC)

A. Stand-alone BC panels shall be microprocessor based, multi-tasking, multi-user, real-time digital control processors. The BC shall provide an interface between the enterprise level operator interfaces and databases, and the building level controllers.

B. Each panel shall have sufficient memory to support its own operating system and database. Non-volatile memory shall be incorporated for all critical controller configuration data and 72- hour battery back-up shall be provided for all volatile memory.

C. All BCs shall communicate on the ELCN as well as the BLCN.

D. Each BC shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASC) and Custom Programmable Controllers (CPC).

E. The BC shall have the following minimum capabilities:
   1. Global control processes
   2. Energy Management Applications
   3. Scheduling
   4. Alarm Management
   5. Historical/Trend Data for all points
   6. Time and Calendar synchronization
   7. Maintenance Support Applications including network management functions for LonWorks® based devices
   8. Operator I/O
   9. Dial-Up Communication
   10. Manual Override Monitoring
   11. Integration of all LonWorks® or BACnet controller data

F. The BC shall provide at least one RS-232C serial data communications ports for simultaneous operations of multiple operator I/O devices such as industry standard printers, laptop workstations, PC workstations and panel mounted or portable Operator Terminals. The BC shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or network terminals.

G. The BC shall monitor the status or position of all hardware overrides and include this information in logs and summaries to inform the operator that automatic control has been inhibited. BCs shall also collect override activity information for daily and monthly reports.

H. The BC shall provide local status indication for each binary input and output for constant, up- to-date verification of all point conditions without the need for an operator I/O device.

I. Each BC shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment. The BC shall provide both local and remote annunciation of any detected component failures or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each BC and shall not require the connection of an operator I/O device.

J. Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high as to allow all signal wiring to run in the same conduit as high voltage wiring where acceptable by electrical code.

K. In the event of the loss of normal power, there shall be an orderly shutdown of all BCs to prevent the loss of database or operating systems software. Upon restoration of normal power, the BC shall automatically resume full operation without manual intervention. Should BC memory be lost for any reason, the user shall have the capability of reloading the BC via the ELCN or via the local RS-232C port.

L. Each BC shall automatically and continuously maintain a history of all associated temperatures to allow users to quickly analyze comfort and equipment performance over the past 24 hours. A minimum of two samples per hour shall be stored.

M. Each BC shall have the ability to collect data for any property of any point connected on its BLCN.

N. The BC shall have the ability to backup its database of points, control processes, logs, trends, histories etc. to the central server.

O. BCs used in conditioned ambient space shall be rated for operation at 32°F to 122°F and 5 to 95% RH, non-condensing. BCs used outdoors shall be rated for operation at -40°F to 140°F and 5 to 95% RH, non-condensing.

2.10 CUSTOM PROGRAMMABLE CONTROLLERS (CPC), APPLICATION SPECIFIC CONTROLLERS (ASC), AND UNITARY THERMOSTAT CONTROLLERS (UTC)

A. General
1. All stand-alone controllers shall communicate on the BLCN.
2. Each controller shall be a microprocessor-based, multi-tasking, real-time digital control processor. Each controller shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network.
3. Each controller shall have sufficient memory to support its own operating system and databases including appropriate energy management applications. Each controller shall retain its program, control algorithms, and setpoint information in non-volatile memory such that a power failure of any duration does not necessitate reprogramming of the controller, and it shall return to normal operation upon restoration of power.
4. The controller's setpoints and input/output point data shall be accessible through any operator workstation, portable operator's terminal, or any BC connected to the BAS system.
5. Each stand-alone controller for major central station systems, i.e., air handling units, heat exchangers, pumping systems, etc., shall have a local display with operator keypad to view/adjust setpoints and start/stop equipment. Provide a means to prevent unauthorized personnel from accessing setpoint adjustments and equipment control functions.
6. The controller shall provide the ability to download and upload configuration data, both locally at the controller and via the BAS communications networks.
7. Provide HOA switches for each digital output and label accordingly.
8. One copy of any programming tool required to configure or program the controllers shall be provided to the Owner along with all appropriate documentation.
9. Controllers used in conditioned ambient space shall be rated for operation at 32°F to 122°F and 5 to 95% RH, non-condensing. Controllers used outdoors shall be rated for operation at -40°F to 140°F and 5 to 95% RH, non-condensing

B. BACnet Controllers
1. Controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Controllers shall be minimum BACnet conformance class 3.
2. Standard BACnet object types supported shall include as a minimum–Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information
3. All controllers shall have BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2001.

C. Custom Programmable Controllers
1. Stand-alone CPCs shall be provided for, but not limited to, the following types of applications as shown on the drawings: Custom Air Handling Units, Boiler Plant and Chiller Plant.

D. Application Specific Controllers
1. Stand-alone ASCs shall support, but not be limited to, the following types of systems to address specific applications as shown on the drawings: Rooftop Air Handlers, VAV/CAV terminal units, and Fan Coil Unit.
2. Application Specific Descriptions:
    a. Fan Coil Unit Controllers:
        1) Fan Coil Unit Controllers shall support, but not be limited to, the operational sequences as described in the drawings.
        2) At a minimum, Fan Coil Unit Controllers shall support the following types of point inputs and outputs:
            a) Modulated heating and cooling control outputs
            b) Space temperature inputs
            c) Analog space temperature setpoint adjustment inputs
            d) Binary unoccupied override inputs
        3) The modes of operation supported by the Fan Coil Unit Controllers shall minimally include, but not be limited to, the following:
            a) Daily / weekly schedules
            b) Occupancy mode
            c) Unoccupied mode

d) Temporary override mode

E. Unitary Thermostat Controllers (UTC)
1. Stand-alone UTCs shall support, but not be limited to, the following types of systems to address specific applications as shown on the drawings: Computer Room Air Conditioning (CRAC) Units, and Cabinet Heaters.
2. The UTC shall support, but not be limited to, the control sequences for these applications as described in the drawings.
3. When applied to a CRAC unit, the UTC shall be powered via the CRAC unit to allow it to operate on emergency power.
4. The UTC shall be a wall mounted controller that can be operated in stand-alone mode and under supervisory mode via the BC.
5. The UTC shall have a local LCD display, and pushbuttons or thumbwheels for local adjustments.
6. At a minimum, the UTCs shall support the following types of point inputs and outputs:
   a. Fan control outputs
   b. Staged heating and cooling outputs
   c. Economizer control outputs
   d. Space temperature inputs
   e. Analog space temperature setpoint adjustment inputs
   f. Binary unoccupied override inputs
7. The modes of operation supported by the UTC shall minimally include, but not be limited to, the following:
   a. Daily / weekly schedules
   b. Occupancy mode
   c. Unoccupied mode

2.11 ELECTRONIC CONTROLS

A. Temperature sensors
1. Space Temperature Sensors
   a. Space temperature sensors shall utilize RTD or thermistor type elements terminated on clamp type connectors or plug-in strip with manufacturer's standard locking cover and shall meet or exceed the following specifications:
      1) Accuracy: ± 1% of sensor range
      2) Sensing Range: 55° F to 85° F
   b. Space temperature sensors shall include the following features:
      1) Public Spaces
         a) Blank Face Sensor with no buttons
         b) Occupied Override (VAV and CAV terminal units): Integral push button
         c) No LCD Display
      2) Private Office Spaces
         a) Setpoint Adjustment: ± 3° F adjustment range
         b) Occupied Override (VRF terminal units): Integral push button
         c) LCD Display
2. Rigid Stem Sensors
   a. Small duct (less than 14 ft2) and pipe mounted sensor shall utilize rigid stem temperature sensors and shall be RTD or thermistor type, with ceramic or epoxy encapsulated wire wound nickel element and shall meet or exceed the following specifications:
      1) Accuracy: ± 0.1% of sensor range
      2) Sensing Range: -50° F to 220° F
      3) Sheath: Stainless steel or copper
      4) Insertion Length (Duct): 8" (4" for terminal unit discharge air temperature)
      5) Insertion Length (Pipe): 2-1/2" in stainless steel or brass thermowell.
   b. Sensors used in liquid measuring applications shall be furnished with compatible thermowells.
   c. Sensors used in duct measuring applications shall be furnished with duct element holder.
3. Averaging Temperature Sensors

a. Large duct (14 ft2 and greater or where shown) and temperature sensors used inside air handling units or rooftop units shall be averaging type sensors, be continuous nickel or platinum element encased in an aluminum capillary, and shall meet or exceed the following specifications:
   1) Accuracy: ± 0.5% of sensor range
   2) Sensing Range: -50° F to 220° F
   3) Length: 8 feet minimum
b. Capillary shall be firmly supported by a system of mechanical clips and be protected from damage due to mechanical vibration.

4. Outside Air Sensors
   a. Outside air sensors shall be RTD or thermistor type, have watertight inlet fittings, be shielded from direct sunlight, and shall meet or exceed the following specifications:
      1) Accuracy: ± 0.1% of sensor range
      2) Sensing Range: -50° F to 220° F

B. Temperature Transmitters
1. Temperature transmitters shall utilize RTD or thermistor elements and shall output a 4- 20 mA linear signal over the specified range.
2. Housings for transmitters mounted on supply ducts or in non-hazardous spaces shall be NEMA 1. Housings for transmitters in outdoor air, on out-door air plenums or intake ducts, or in spaces whose ambient temperature is below 55°F, shall be gasketed die- cast aluminum, NEMA 3R minimum.
3. Transmitters in outdoor air shall be provided with approved sun shields.
4. Transmitters shall meet or exceed the following specifications:
   a. Zero Point and Span Adjustment: Adjustable over a minimum of 75% of range
   b. Range:
      1) Space: -50° F to 120° F
      2) Duct: -50° F to 300° F
      3) Outside Air: -50° F to 150° F
      4) Chilled Water: -50° F to 200° F
      5) Hot Water: -50° F to 300° F

C. Humidity Transmitters
1. Humidity transmitters shall utilize thin film polymer capacitor sensing, shall output a linear 4-20 mA or DC voltage signal over the instrument range. Output shall be temperature compensated, and shall meet or exceed the following specifications:
   a. Accuracy: ± 2% R.H. over entire range
   b. Hysteresis: 1% R.H. maximum
   c. Stability: ± 1% R.H. maximum per year
   d. Range: 0% to 100% R.H. (non-condensing)
2. Humidity transmitters shall be enclosed in NEMA 1 housing minimum. Transmitters in outdoor air or on outdoor air intake plenums or ducts shall be enclosed in NEMA 3R housing. In addition, transmitters in outdoor air shall be housed within a baffled aluminum or stainless steel rain shield.

D. Differential Pressure Transmitters – Air Systems.
1. Differential pressure transmitters shall measure pressure signals from space or duct probes and shall output a linear 4-20 mA or DC voltage signal.
2. Transmitter range shall be selected for the application. Transmitter full span shall not exceed twice the maximum system operating pressure in W.C.
3. Differential pressure transmitters shall meet the following performance standards as a minimum:
   a. Accuracy: ± 1% of F.S. (includes hysteresis, linearity, and repeatability)
   b. Over-Range Protection: 28" W.C.
   c. Calibration: Zero point and span adjustable to within 0.1% of full span
4. Transmitter shall include a second order, low pass active electronic filter to eliminate input signal noise from the output signal.

5. Duct static pressure probes shall be single probe type, with rounded tip, mounting flange and extended connection. Construction shall be extruded aluminum or stainless steel. Sensor and transmitter shall be enclosed in NEMA 1 housing minimum.

E. Static Pressure Sensing – Air Ducts
1. Elements
   a. Static pressure sensing elements for air ducts having horizontal or vertical dimension of 36 inches or greater shall be the traverse probe type. Probe shall be constructed of extruded aluminum or stainless steel and shall contain multiple static pressure sensing points connected to an averaging manifold to produce a non-pulsating signal with an accuracy of ± 1%. Shall be enclosed in NEMA 1 housing minimum.
      1) Accuracy: Overall ± 1% of span
   b. Static pressure sensing elements for air ducts having horizontal or vertical dimension of less than 36 inches shall be single probe type, with rounded tip, mounting flange and extended connection. Construction shall be extruded aluminum or stainless steel. Shall be enclosed in NEMA 1 housing minimum.
      1) Accuracy: Overall ± 1% of span
2. Transducers
   a. Transducers shall measure pressure signals from the duct probes and shall output a linear 4-20 mA or DC voltage signal.
   b. Transducer range shall be selected for the application.
   c. Transducers shall meet the following performance standards as a minimum:
      1) Accuracy: ± 1% of F.S.
   d. Static pressure transducers shall be located in the control panel. Sensing tubes shall be run from the sensing element to the transducer.

F. Carbon Dioxide Sensors
1. Carbon dioxide sensors (CO2) shall measure conditions from space or duct and shall output a linear 4-20 mA or DC voltage signal. Sensors shall utilize non-dispersive inferred technology (NDIR) and meet or exceed the following specifications:
   a. Accuracy: ± 50 ppm
   b. Range: 0 to 2000 ppm
   c. Response Time: 2 minutes
   d. Drift: Less than 30 ppm/year
   e. Calibration Interval: 5 years
   f. LCD Display

G. Flow Meters/Transducers:
1. The flow transducers shall utilize a nonmagnetic sensing mechanism with a forward- swept rotating impeller to produce a frequency signal proportional to flow. The flow transducers shall have an achievable accuracy of +/-1 percent of flow rate with flow velocities of 1 to 30 fps.
2. The flow meter shall be constructed of brass with a glass reinforced impeller, tungsten carbide shaft and glass reinforced polyphenylene sulfide housing. The unit shall be both insertable and removable through a gate type valve when the pipe is under pressure.
3. Provide minimum of 10 straight pipe diameters upstream and 5 diameters downstream for each field installed flow transducer.
4. Provide an insertion/extraction tool as needed to allow removal and replacement of flow transducer while the system is under pressure.
5. Flow Transducer shall be equivalent to Onicon F-1210 with 4-20 mA signal.

2.12 ELECTRIC CONTROLS

A. Differential Pressure switches 0" to 10" W.C. – Air
1. Switch shall be diaphragm actuated SPDT, minimum rating 5 amps resistive 120 VAC, enclosed in NEMA 1 housing. Maximum deadband shall be 0.30 inches W.C. Setpoint shall be fully adjustable over switch range.
2. Diaphragm material shall be silicone rubber or Buna-N. Actuator assembly enclosure shall be entirely of aluminum or steel. Switches mounted outdoors, within panels located outdoors, or

within ducts or plenums shall be provided with NEMA 4 enclosures. Pressure connections shall be NPT.

3. Differential pressure switches shall be Barksdale, Mercoid or Dwyer.

B. Current Operated Switches - Equipment Status
1. Switch shall be self powered, solid state with an adjustable current sensing range of 1 to 175 amps.
2. Device shall be suitable for 175% of rated motor equipment current.

C. Limit Switches:
1. Limit switches shall have a minimum rating of 10 amps resistive at 120 VAC. Switch assemblies shall be two pole single or double throw, and enclosure shall meet NEMA 3R requirements as a minimum. Switch actuation rod shall be aluminum or stainless steel.

D. Electric Space Thermostats
1. Provide wall mounted or unit mounted electric space thermostats as indicated on the Drawings.
2. Electric space thermostats shall be heavy duty type, with contact rating exceeding the switched load. Setpoint adjustment shall be concealed.
3. Provide heavy duty lockable transparent guards for all thermostats switching line voltage (120 VAC) and all thermostats located in public areas.

E. Control Relays
1. Control relay contacts shall be rated for no less than 140% of the switched load, or a minimum continuous rating of 10 amps at 120 VAC. Relay coils shall be rated for continuous duty at 100% + 10% of the normal coil pilot voltage.
2. Relays mounted within panels may be plastic encapsulated socket mounted type or modular design with multiple convertible contacts, as required.
3. Relays located outside of panels shall be housed in enclosures rated for the intended location.
4. All relays shall contain an indicator light to show the energized/de-energized status of the relay coil.

2.13 ELECTRONIC ACTUATORS FOR DAMPERS

A. Actuators shall include electronics to receive the digital controller's signal. Torque of the actuator shall be the working pressure of the system for valves, the total static differential of an air system, plus 25% safety factor.

B. Actuators shall have a spring return to the fail safe position.

2.14 DAMPERS

A. Dampers required for the systems shall be furnished under this automatic control subcontract, except where specifically required to be furnished with the air handling units. Dampers shall be turned over to the Sheet Metal Subcontractor, together with complete instructions for installation. Where modulating operation is required of the dampers, they shall be opposed blade type. Parallel blade dampers are acceptable only on mixing applications. Mixing sections may have parallel blade dampers on the return air and opposed blade dampers on the outside air.

B. Dampers shall be constructed with not larger than 6" blades and not less than 16-gauge construction, mounted on a 2" channel frame, complete with bronze or nylon bearings and heavy duty connecting control links. All dampers shall be rugged construction and very tight fitting with rubber edges on both edges of each blade and compression type jamb seals on the frame.

C. Dampers shall be low-leakage type, as required to meet the requirements of ASHRAE Standard 90.1.

D. Maximum panel size is 48" wide x 48" high. Damper blades shall be galvanized steel or aluminum. Provide a damper operator for each panel. No jack-shafting is permitted. The Sheet Metal Subcontractor will install access doors to inspect and service the dampers.

2.15 CONTROL PANELS

A. BAS control panels/enclosures shall be provided and installed where shown on the associated HVAC Drawings and where needed for complete installation of BAS components. Coordinate mounting locations and utility requirements with other trades.

B. All controllers, transformers, power supplies and relays shall be mounted in enclosures. These items may also be mounted within the HVAC equipment's control section if permitted by the HVAC equipment manufacturer, and if adequate space is provided.

C. Enclosures shall be designed for control and instrumentation applications, able to be mounted directly on the wall, and capable of adequately protecting the enclosed product in the environment in which it is mounted.

D. Enclosures shall not be mounted directly on HVAC equipment such as air handling unit housings. Field constructed Unistrut racks may be used where necessary, provided rack is constructed adequately to support the enclosure.

E. Enclosures shall be NEMA 1 or as required by the location and local code requirements when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 or as required by the location and local code requirements when installed in other than a clean environment. Outdoor enclosures and/or enclosures in wet ambient conditions shall be weatherproof.

F. Enclosures shall have hinged, locking doors.

2.16 AIRFLOW MEASURING SYSTEMS

A. Airflow Measuring Systems shall consist of an airflow element (duct or fan inlet) and an electronic transducer.
   1. Airflow measurement elements location and sizing shall be confirmed in the field by local factory representative. Velocity calculation and corresponding differential pressure calculations will be calculated accordingly.
   2. Elements shall be installed in strict accordance with the manufacturer's published requirements; therefore, it shall be the responsibility of the contractor to verify and installation, to assure that accurate primary signals are obtained.

B. Airflow Element:
   1. Airflow elements shall be designed and built to comply with accepted practice for traversing as defined in the ASHRAE Handbook of Fundamentals. The number of sensing points on each element, and the quantity of elements utilized at each installation, shall comply with ASHRAE Standard #111 for equal area traversing.
      a. Signal amplifying sensors requiring flow correction (K factors), or employing reduced sensing points less than ASHRAE Standard #111 are not acceptable.
      b. Direct pressure readings are required. Indirect sensing methods such as thermal mass flow wires, subject to humidity limitations and insulating effects produced by commonly present particulate matter shall not be acceptable.
   2. Differential pressure sensing elements shall be constructed of anodized aluminum or stainless steel and shall contain multiple static pressure sensing points connected to an averaging manifold to produce a non-pulsating signal.

C. Electronic Transducers:
   1. Each transducer shall be selected for its respective duty. Outside Air, Supply, Exhaust and/or Return airflow.

2. Transducers shall output a linear 4-20mA or 0-10VDC signal of the corresponding CFM airflow value. The transducer shall be factory set for a full scale value equal to 110% of the maximum design capacity of the flow measuring element served for variable air volume applications, or 200% of the design operating value for constant volume applications.
3. Each transducer shall have integral square root function, scaling function, and filter.

D. Fan inlet airflow measuring systems shall meet or exceed the following specifications:
1. Full Scale Accuracy: ± 0.25%
2. Velocity Range: 0 to 10,000 fpm
3. At the Contractor's option, airflow measuring devices utilizing the principle of vortex shedding for air velocity measurement may be used for fan inlet airflow measurement, and shall meet or exceed the following specifications:
   a. Full Scale Accuracy: ±0.5%
   b. System Accuracy: ±2% of flow rate

E. Duct airflow measuring systems shall meet or exceed the following specifications:
1. Full Scale Accuracy: ± 0.25%
2. Velocity Range: 0 to 5,000 fpm

F. Outside airflow systems shall meet or exceed the following specifications:
1. System Accuracy: ±3% of flow rate
2. Full Scale Accuracy: ±0.5%
3. Velocity Range: 180 to 1,4000 fpm
4. Outside airflow measuring systems shall additionally include a local LCD readout of airflow value in CFM, shall auto zero, and shall have temperature compensation to correct for air density.

G. Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Air Monitor Corp.
2. Paragon Controls, Inc.
3. Tek-Air
4. Ultratech

2.17 LICENSE AGREEMENT SOFTWARE

A. The BAS Contractor agrees to provide to the Owner and Owner agrees to accept the software products provided under these specifications. A software licensing agreement shall be executed between the BAS Contractor and the Owner's authorized signatory before the software is distributed. This licensing agreement shall grant to the Owner a non-exclusive license to use the software product solely for Owners' own use on the designated installation.

B. All project developed software shall be turned over to and become property of the Owner. This shall include all ASC and CPC programs, graphic images, and project databases.

2.18 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27.

2.19 CONTROL TUBING

A. Control tubing shall be furnished and installed complete, connected up and operating to serve all pressure sensing devices (e.g. static pressure sensors, etc.) and all pneumatic control devices required to accomplish the specified functions

B. Tubing shall conform to the following:
   1. Hard Copper - Tubing shall be hard copper with wrought copper or bronze fittings with solder joints. Hard copper may be used without restrictions.
   2. Soft Copper - Tube shall be annealed soft copper with flared or compression joints. Soft copper shall not be used in exposed locations except at final connection to devices.
   3. Polyethylene, Open - Tubing shall be fire retardant, self-extinguishing, virgin polyethylene, single or multiple tube. Tubing shall meet requirements of ASTM Tests D638 and D1693

2.20 IDENTIFICATION LABELS

A. Component Identification
   1. Label all sensing devices, controllers, transducers and actuation devices. Identify and label each item as they appear on the control shop drawing diagrams.
   2. Labels shall be preprinted or computer-printed type. “P-Touch” or other consumer style labels are acceptable.
   3. Labeling scheme must be approved by the owner, any labeling not approved by the owner and engineer shall be relabeled at the contractor’s expense.

B. Cable and Wire Identification
   1. Label all wires and connectors at each end with marker tape. Identify and label each item as they appear on the control shop drawing diagrams.
   2. Provide temporary cable labels for use during cable pulling and installation; provide permanent type printed labels on cable after cables are terminated.
   3. Label each cable between 2 and 6 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
   4. Marker tape shall be vinyl or vinyl-cloth, self-adhesive wraparound type, with cable/wire identification machine printed by thermal transfer or equivalent process.
   5. Labeling scheme must be approved by the owner, any labeling not approved by the owner and engineer shall be relabeled at the contractor’s expense.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all conduit, wiring and cable, and install all equipment in first-class manner, using proper tools, equipment, hangers, and supports, and in locations as required for a neat, attractive installation. No material shall be exposed if it is possible to conceal it. Exposed material shall be installed only with consent of the Engineer.

B. Install the system as recommended by the Manufacturer, using only equipment recommended or acceptable to the Manufacturer.

C. Support all sensors as recommended by the Manufacturer where inside equipment, such as ductwork. Sensors in the space shall be in small, attractive housings designed for that purpose and mounted on an electrical junction box.

D. Control tubing shall be supported at frequent intervals to prevent sagging (4 ft. centers maximum for soft copper). Tubing run in exposed areas shall be run in an inconspicuous manner following natural building lines. In finished portions of the building, tubing shall be run concealed.

E. Extreme care shall be used in making connections to other equipment, such as boilers and chillers, to see that the safeties on this equipment are not inadvertently by-passed or overridden by the BAS.

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install labels to identify all control components.

H. All equipment having moving parts and controlled by the BAS shall be provided with warning labels no less than 2" (50mm) in height, and in bright warning colors, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 except wiring smaller than No. 12, where ½" size conduit may be used.

B. Install building wire and cable according to Division 26 except as explicitly noted below.

C. Install communication, signal, and fiber-optic cables according to Division 27.

D. Comply with all codes for electrical work. Run all power wiring in conduit. All sensor and control wiring located in mechanical rooms and other exposed areas shall be run in conduit. All wiring run inside the walls shall be in conduit. All equipment located outside shall be in suitable weather tight enclosures.
   1. Low voltage wiring concealed above accessible ceilings does not require conduit except as required in air plenums.
   2. Open wiring in air plenums shall be UL Listed for such use and so labeled, otherwise it shall be run in conduit.
   3. Open wiring shall be bundled and supported at 3 ft. intervals with a system of J-hooks and plastic tie wraps secured to permanent building structure.

E. Circuits serving control panels and transformers for low voltage service shall be independent and used for no other purpose. These shall originate from the nearest appropriate electrical panel. Circuit wiring from the electrical panel shall be included in this contract. These circuits shall be clearly identified at the panels. Coordinate with the Electrical Contractor.

3.3 SOFTWARE

A. Load and debug the software to provide a complete operation BAS system, and operate the system to prove function of each system. Where necessary, the sensor shall be heated or cooled to demonstrate the correct function. Provide careful evaluation of the operation of chillers and boilers at part and full load under control of the BAS.

B. The BAS Contractor shall review the programs with the Engineer in the programming stage to make sure that the programmer understands the Engineer's intent and that the program will carry out that intent.

C. Provide the Owner with a bound copy of the complete information on the equipment and all components, including programming, as well as instruction books on reprogramming of the system for future modifications of the system, if desirable.

3.4 SYSTEM DEMONSTATION, VALIDATION AND ACCEPTANCE

A. The Contractor shall satisfactorily demonstrate the complete operating sequence, including daily mode changes, seasonal mode changes and any associated energy management routines for all equipment being controlled including, but not limited to:
   1. Air handling units
   2. Exhaust air systems

3. VRF Systems
4. Miscellaneous equipment, including but not limited to the following:
    a. Ventilation systems
    b. Cabinet heaters
    c. Unit heaters
    d. Lighting control integration

B. The Contractor shall satisfactorily demonstrate the proper operation of all associated system points as defined in drawings, including but not limited to the following:
1. All analog input sensing device readings, including temperature, humidity, pressure, flow, volume, CO2 sensors, etc.
2. All analog output controls including valves, dampers, speeds, etc., including proper ranging.
3. All binary input status reading.
4. All binary output or two position controls including start/stops, open/closed, on/off, etc.
5. All pulsed inputs including flow meters, electric meters, etc., including proper ranging.

C. Upon the completion of all work, tests and specific function demonstrations, and at a time agreed upon, the Architect and the Contractor shall, in conjunction with other contractors, operate the systems installed by him/her, in all parts, at his/her own expense for sufficient length of time to demonstrate the mode of operation and definitely determine whether the systems as a whole are in first-class working condition. Any defects that may develop during this demonstration period shall be immediately corrected by the Contractor at his/her own expense, and the systems placed in first-class working condition. Contractor shall return to site in season to demonstrate (and instruct operating personnel) an additional 24 hours so that both heating and cooling season operation is demonstrated.

D. Final Check-Test-Start of System Summary
1. Check and/or oil all electric motors furnished under control system.
2. Lubricate all damper bearings.
3. Check damper travel, adjust and tighten all set screws.
4. Lubricate valve stems, check packing.
5. Calibrate all instruments.
6. Check and verify all circuitry.
7. Calibrate and check all controllers, fusing, and electrical connections.
8. Run software through program diagnostics and debug as required.
9. Startup and test operation of variable frequency drive with factory authorized personnel.

3.5 TRAINING

A. All training shall be by the BAS manufacturer and shall utilize specified manuals, as-built documentation and on-line help utility. All training sessions shall be video recorded and shall become property of the Owner upon completion of training. Media format for video recording shall be coordinated with the Owner. Refer to Division 01 Section "Demonstration and Training."

B. Operator training shall include a minimum of forty (40) hours encompassing, but not limited to the following topics:
1. Sequence of Operation review.
2. Sign on-Sign off.
3. Selection of all displays and reports.
4. Commanding of points, keyboard and mouse mode.
5. Modifying English text.
6. Use of all dialogue boxes and menus.
7. Modifying warning limits, alarm limits and start-stop times.
8. System initialization.
9. Download and initialization of all stand-alone DDC panels and ASCs.
10. Purge and/or dump of historical data.
11. Use of Portable Operators Terminal.
12. Troubleshooting of sensors (determining bad sensors).
13. System maintenance procedures.

C. Supervisor training shall include an additional minimum of eight (8) hours encompassing, but not limited to the following topics:
   1. Password assignment/modification.
   2. Operator assignment/modification.
   3. Operator authority assignment/modification.
   4. Point disable/enable.
   5. Terminal and data segregation/modification.
   6. Use of portable operator terminal.
   7. Use of spreadsheet package with system data.

D. Programmer training shall include a minimum of two (2) additional four (4) hour sessions encompassing, but not limited to the following topics:
   1. Software review of Sequence of Operation flowcharts.
   2. Use of CPC/ASC programming tool including use of any associated plug-ins.
   3. Modification of control programs, including all server, BC, CPC, and ASC programs.
   4. Add/Delete/Modify data points.
   5. Use of diagnostics.
   6. System maintenance procedures.
   7. Review of initialization.
   8. Upload/download and off-line archiving of all system software.
   9. Creating and modifying color graphics.

E. Operator training shall be performed on site and specific dates/times shall be coordinated with the Owner. Programmer training shall be for Owner-designated personnel and shall be scheduled by the Owner with two week notice anytime during the warranty period.

F. Printed training material shall be provided by the contractor to all training event attendees.

END OF SECTION 23 09 00

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sheet metal ducts and fittings.
2. Sheet metal materials.
3. Duct liner.
4. Rectangular duct connection systems.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Requirements

1. ANSI/SMACNA 006-2006 (SMACNA 006) HVAC Duct Construction Standards – Metal and Flexible Third Edition. All ductwork shall be in conformance with this standard.
2. Structural Performance: Duct hangers, supports, and seismic restraints (where applicable) shall withstand the effects of gravity, wind, and seismic loads and stresses within limits and under conditions described in SMACNA 006, ASCE/SEI 7, and local requirements.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.2 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by the Architect/Engineer. Accompany requests for layout modifications with calculations showing the proposed layout will provide original design results without increasing system total pressure.

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of the following products:

   a. Prefabricated ductwork and fittings.
   b. Liners and adhesives.
   c. Rectangular duct connection systems.
   d. Sealants and gaskets.
   e. Seismic-restraint devices.

2. Shop Drawings:

   a. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   b. Fittings, including details of construction.

c. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
d. Elevations of top and bottom of ducts along with applicable elevations of structural elements.
e. Dimensions of main duct runs from building grid lines.
f. Reinforcement and spacing.
g. Duct material and gauge thickness by pressure class.
h. Seam and joint construction.
i. Penetration details through fire-rated, smoke barriers and other rated partitions.
j. Equipment installation based on equipment being utilized on this project.
k. Duct accessories, including dampers, turning vanes, and duct access doors.
l. Length of application of acoustic duct liner where it will be applied.
m. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
n. Other systems installed in the same space as ducts where order of installation affects access.
o. Ceiling and wall mounted access doors and panels required to provide access to dampers, controls and other operating devices.
p. Ceiling mounted items, including light fixtures, diffusers, grilles, speakers, smoke detectors, sprinklers, other electrical devices, equipment and building structural members.
q. On each drawing, include a tabular list of each fan system's ductwork represented on that drawing and the total square foot surface area of each fan's duct system illustrated on the drawing.
r. Shop drawings shall be submitted prior to the fabrication or installation of the ductwork and serve as the foundation for coordination between various trades to maintain required ceiling heights.

3. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

a. Test procedures used.
b. Test results that comply with requirements.
c. Failed test results and corrective action taken to achieve requirements.

B. Leakage Testing Documentation: Contractor shall submit a written report to the authority having jurisdiction in which ducts designed at static pressures more than 3" wg pressure class have been leak tested and that the air leakage class is less than 6.0 per the Energy Code. Provide duplicate submittal to the Owner and the Engineer.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for steel hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum hangers and supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance: Applicable requirements in:

1. NFPA 90A.
2. NFPA 90B.
3. NFPA 96.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1.

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Damage: Handle, transport, and store ducts to avoid damage. Damaged ductwork is not acceptable.

B. Protection: Protect ducts from mechanical damage, weather, and exposure to chemicals (including road salt). Do not permit insulation materials to get wet under any circumstances. Remove insulation that is or has been wet from the project site, and replace the insulation with undamaged new materials.

C. Ductwork and associated components shall be stored on blocking in a clean dry area to prevent damage and to prevent the entrance of dirt, debris, foreign matter and moisture.

D. Ductwork shall be adequately supported during storage to prevent sagging or bending.

E. Provide temporary storage, delivery and handling in accordance with SMACNA Duct Cleanliness for New Construction Guidelines, Intermediate Level.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA 006 based on indicated static-pressure class. The figure numbers below reference that standard.

1. Transverse Joint: Figure 2-1.
2. Longitudinal Seam: Figure 2-2.
3. Pressure Class Gage and Reinforcement: Table 2-1 through Table 2-52 and Figure 2-3 through Figure 2-18.
4. Elbow: Figure 4-2 (Use the following types only unless specifically approved by the Engineer.):

    a. Type RE 1 (radius elbow).
    b. Type RE 2 (square throat elbow with turning vanes).
    c. Type RE 3 (radius elbow with vanes).
    d. Type RE 5 (dual radius elbow).
    e. Type RE 6 (mitered elbow without turning vanes) only for angles not greater than 45 degrees.

5. Turning Vanes: Figures 4-3 and 4-4. Figure 4-9 short radius vanes in accordance with Chart 4-1 are acceptable.
6. Branch Connection:

    a. Diverging Flow: Figure 4-5 (all types). Figure 4-6 (following types only):

        1) 45-degree entry to rectangular branch.
        2) 45-degree lead-in to round branch.
        3) Conical connection.
        4) Bellmouth connection.
        5) Conical or bellmouth spin-in fitting only for pressure class 2” WG or less.

    b. Converging Flow: Figure 4-5 (all types) and Figure 4-6 (all types). Conical or bellmouth spin-in fitting is acceptable only for pressure class 2” WG or less.

7. Offset, Transition, or Obstruction: Figure 4-7 (all types) and Figure 4-8 (Figure B and C). Do not use Figure 4-8 Figure A (pipe through duct), Figure D (mitered offsets around obstruction, or Figure E (split duct around obstruction) unless specifically approved by the Engineer.

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. McGill Airflow LLC.
2. Sheet Metal Connectors, Inc.

B. Duct Size: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA 006 based on indicated static-pressure class.

D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A; and NAIMA AH124.

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
3. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
4. Coat insulation with antimicrobial coating.
5. Cover inner surfaces of insulation with polyester film complying with UL 181, Class 1.

E. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A.

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
3. Maximum Temperature: 180 deg F.

F. Inner Duct: Minimum 24-gauge (0.028-inch) galvanized steel, stainless steel, or aluminum as indicated. Inner duct having 3/32-inch-diameter perforations, with overall open area of 23 percent. Solid, unperforated inner duct in fittings unless otherwise indicated. Solid, unperforated inner straight duct only if so indicated.

G. General Fabrication Requirements: Conform to the equivalent single-wall duct requirements in the “Single-Wall Rectangular Ducts and Fittings” Article above based on the static pressure class and the size of the outer duct.

2.3 SINGLE-WALL ROUND OR FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA 006 Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

   a. Eastern Sheet Metal.
   b. FlaktGroup SEMCO.
   c. Lindab Inc.
   d. McGill AirFlow LLC.
   e. Sheet Metal Connectors, Inc.

2. Transverse Joint: Figure 3-1 (all types).

3. Longitudinal Seam: Figure 3-2 (all types). Do not use type RL-5 (grooved seam pipe lock or flat lock), RL-6 (snaplock), RL-7 (snaplock), or RL-8 (snaplock) seam for duct over 1" WG pressure class. Fabricate round duct larger than 90-inch diameter with butt-welded longitudinal seam.
4. Pressure Class Gage and Reinforcement: Table 3-2 through Table 3-15 and Figure 3-3.
5. Elbow: Figure 3-4. Use centerline radius of 1.5 diameters for each elbow unless space constraints prevent a radius that large; in that event, the radius may be reduced to that indicated in Table 3-1 with mitered segments. If space constraints prevent a radius as large as indicated in Table 3-1, a mitered elbow with turning vanes similar to Figure 4-3 and Figure 4-4 may be used. Do not use an adjustable elbow for duct over 1" WG pressure class.
6. Branch Connection with Diverging or Converging Flow: Figure 3-5 and Figure 3-6. All types are acceptable for pressure class 2" WG or less duct. For pressure class 3" WG or more duct, use 90-degree tee fitting with oval-to-round tap, 45-degree lateral fitting, conical fitting, or wye fitting. Reducers may be incorporated into the fitting. Use only factory-fabricated fittings, not saddles or field-fabricated taps, for pressure class 3" WG or more duct.
7. Offset, Transition, or Obstruction: Figure 4-7 and Figure 4-8 modified for round or flat oval duct. Do not use Figure 4-8 Figure A (pipe through duct), Figure D (mitered offsets around obstruction), or Figure E (split duct around obstruction) unless specifically approved by the Engineer.
8. Flat Oval: Figure 3-7 and applicable figures for equivalent round duct.

2.4 DOUBLE-WALL ROUND OR FLAT-OVAL DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Eastern Sheet Metal.
2. FlaktGroup SEMCO.
3. Lindab Inc.
4. McGill Airflow LLC.
5. Sheet Metal Connectors, Inc.

B. Outer Duct: Comply with SMACNA 006 Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class.

C. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A; and with NAIMA AH124.

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
3. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
4. Coat insulation with antimicrobial coating.
5. Cover inner insulation surfaces with polyester film complying with UL 181, Class 1.

D. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
3. Maximum Temperature: 180 deg F.

E. Inner Duct: Minimum 24-gauge (0.028-inch) galvanized steel, stainless steel, or aluminum as indicated. Inner duct having 3/32-inch-diameter perforations, with overall open area of 23 percent. Solid, unperforated inner duct in fittings unless otherwise indicated. Solid, unperforated inner straight duct only if so indicated.

F. General Fabrication Requirements: Conform to the equivalent single-wall duct requirements in the “Single-Wall Round or Flat-Oval Ducts and Fittings” Article above based on the static pressure class and the size of the outer duct.

2.5 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA 006 for material thicknesses and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 unless otherwise indicated.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 or G90.
2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils on sheet metal surface of ducts and fittings exposed to corrosive conditions and minimum 1 mil on opposite surface.
3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts, listed and labeled for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated.

F. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

G. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surfaces of the duct. Apply an untreated clear coating to the exterior surfaces.
2. Antimicrobial compound tested for efficacy by a nationally recognized testing laboratory and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound with a minimum hardness of 2H when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723.
5. Shop-Applied Coating Color: Black or white, as indicated.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

H. Reinforcement Shapes and Plates:
1. Steel Duct: ASTM A 36/A 36M, steel plates, shapes, and bars; black or galvanized.
2. Aluminum Duct: ASTM B209 alloy 6061-T6 members or steel members isolated from the aluminum with butyl rubber, neoprene, or EPDM gasket materials.
3. Other Duct Materials: Reinforcement materials compatible with the duct materials at contact points.

I. Tie Rods: Materials compatible with duct materials. Galvanized steel or stainless steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.6 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, and NAIMA AH124.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Owens Corning.
    b. CertainTeed Corporation: Insulation Group.
    c. Johns Manville.
    d. Knauf Insulation.

2. Maximum Thermal Conductivity:

    a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy and registered by the EPA for use in HVAC systems.
4. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
5. Water-Based Liner Adhesive: Comply with NFPA 90A and with ASTM C 916.

    a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Aeroflex USA Inc.
    b. Armacell LLC.
    c. Rubatex International, LLC.

2. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
3. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A. For indoor applications, adhesive with a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- or 0.135-inch diameter shank, length to suit depth of insulation indicated with integral galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel, aluminum, or stainless steel (as appropriate); with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

D. Shop Application of Duct Liner: Comply with SMACNA 006 Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not install liner in rectangular ducts with longitudinal liner joints at locations other than corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Lined duct following unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are 2500 fpm or more.
    d. Other locations as indicated.

9. Terminate liner with buildouts (metal hat sections) at dampers, turning vane assemblies, or other devices. Secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.7 RECTANGULAR DUCT CONNECTION SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Ductmate Industries, Inc.
2. Hart & Cooley, Inc. Ward Industries.
3. McGill Airflow LLC.

B. Connection System: Rectangular duct transverse joint connection, reinforcement, and sealing system with roll-formed metal flanges, metal corner pieces, sealants, gaskets, and cleats.

2.8 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a flame-spread index no greater than 25 and a smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Sealant: Modified styrene acrylic.
3. Water resistant.
4. Mold and mildew resistant.

5. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
6. Service: Indoor and outdoor.
7. Service Temperature: Minus 40 to plus 200 deg F.
8. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
9. For indoor applications, sealant with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). For school projects, sealant complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). For school projects, sealant complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts or other materials compatible with duct materials.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods; galvanized rods with threads painted with zinc-chromate primer after installation; or stainless steel all-thread rods and nuts.

C. Strap and Rod Sizes: Comply with SMACNA 006 Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Cables:

1. Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
2. Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
3. End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Structural shapes and plates of materials compatible with duct materials and environmental conditions. Support material shall match duct construction material.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION GENERAL REQUIREMENTS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction losses for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings or Coordination Drawings.

B. Install ducts according to SMACNA 006 unless otherwise indicated.

C. Unless otherwise indicated, install ducts vertically plumb or horizontally level, and parallel and perpendicular to building lines. Avoid diagonal runs to maximum extent possible.

D. Install ducts with a minimum clearance of 2 inch plus allowances for insulation thickness and access requirements.

E. Cable hangers may only be used on low pressure (2” wg construction and lower) round spiral ductwork which is not insulated and has a diameter 10” or less. Utilize the double lock method such that the lower loop is clinched tight to the ductwork and the cable is vertical. Utilize manufacturer’s top attachment device.

F. Provide duct offsets needed to avoid interferences with structure, finishes, piping, other ducts, conduit, etc. Coordinate the work with all trades to minimize such offsets. Install ducts with fewest joints possible.

G. Do not penetrate ducts with conduit or piping.

H. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

I. Secure couplings with sheet metal screws. Install screws at maximum intervals of 12”, with a minimum of 3 screws in each round metallic duct coupling.

J. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections. Do not field-cut taps for branch connections in ducts with SMACNA pressure class magnitude more than 2 in wg.

K. Install round or flat-oval ducts in maximum practical lengths to minimize joints.

L. Do not install any duct in an electrical equipment room unless that duct serves that room.

M. Do not install any duct in an elevator equipment room unless that duct serves that room.

N. Do not install any duct over an electrical transformer, electrical switchgear, or an electrical panel unless approved in writing by the Engineer.

O. Maintain clearances required in the National Electric Code for electrically-powered items.

P. Where ducts pass through interior partitions or exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal type and thickness as the duct. Overlap openings on all sides by at least 1-1/2 inches.

Q. Where ducts pass through fire-rated partitions, install fire dampers unless otherwise indicated. Comply with requirements in other Division 23 Sections for fire dampers.

R. Where ducts pass through smoke partitions, install smoke dampers unless otherwise indicated. Comply with requirements in other Division 23 Sections for smoke dampers.

S. Install ductwork takeoffs at smoke dampers such that there is a minimum of 24” between the damper and the start of the first takeoff.

T. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts that are to be exposed in finished spaces from damage including dents, surface scratches, and markings. Exposed ducts must be undamaged and present a clean, neat appearance in materials and workmanship.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system in finished spaces.

C. Grind welds to provide smooth surfaces free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets and inlets.

E. Repair or replace ducts that do not comply with these requirements.

3.3 DUCT SEALING

A. In accordance with ASHRAE 90.1, seal all ducts to SMACNA 006 seal class A with all transverse joints, longitudinal seams, and duct wall penetrations sealed. Seal openings for rotating shafts (including dampers) with bushings or other devices. However, do not seal an opening if sealing the opening would void a manufacturer’s listing. Spiral lock seams in round or flat oval ducts do not require sealing unless leakage is detected.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA 006 Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

C. Hanger Spacing: Comply with SMACNA 006 Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports. Other types of hangers may be used if so indicated or if approved by Engineer.

E. Vertical Ducts: Support vertical ducts with steel angles or channel secured to the sides of the ducts with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at maximum intervals of 16 feet.

F. Upper Attachments: Install upper attachments secured to structural members. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials. Do not attach duct supports to roof decks.

3.5 CONNECTIONS

A. Make connections to motorized equipment with flexible connectors complying with other Division 23 Sections. Comply with SMACNA 006 for branch, outlet, inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a primer compatible with the duct material.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test ductwork sections that have a design static pressure class magnitude of 4-inch wg or more regardless of duct locations. Test representative duct sections totaling no less than 50 percent of total installed duct area. Obtain Engineer’s approval of specific sections to be tested beforehand.
3. Test all ductwork located outdoors.
4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give at least seven days notice for testing.
8. Tests must demonstrate that tested ducts meet SMACNA leakage class 4 or less. If any tested section of ductwork fails to meet this requirement, perform the following at no additional cost to the Owner:

    a. Leak test 100 percent of the ductwork in every duct system with any failed section.
    b. Provide additional sealing of ductwork to eliminate excessive leakage in failed sections. If necessary, replace duct sections.
    c. Retest 100 percent of the ductwork in every duct system with any failed section.
    d. Continue sealing and retesting until the entire system is proven to meet the leakage requirement. Note that once a section is proven to meet the leakage requirement that section does not need to be tested again unless it is damaged later.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Engineer, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems." The cleanliness level is acceptable if the net weight of debris collected on the filter media does not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CONSTRUCTION REQUIREMENTS

A. Fabricate ducts with materials, pressure classes, and insulations indicated on Drawings.

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SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Manual volume dampers.
2. Flange connectors.
3. Turning vanes.
4. Duct-mounted access doors.
5. Flexible connectors.
6. Duct accessory hardware.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product.

a. For fire-dampers, smoke-dampers, combination fire- and smoke-dampers, and ceiling dampers include installation instructions.
b. For smoke-dampers and combination fire- and smoke-dampers include power, signal, and control wiring diagrams.
c. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Closeout Submittals:

1. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

C. Maintenance Material Submittals:

1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

2. Fusible Links: Furnish quantity equal to at least 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A and NFPA 90B.

B. Comply with SMACNA 006 for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or Type 316 as indicated. Unless indicated otherwise, No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Ruskin Company.
2. American Warming and Ventilating.
3. McGill Airflow LLC.
4. Nailor Industries Inc.
5. Pottorff.
6. Safe Air – Dowco Products.
7. Vent Products Co., Inc.

B. Round Manual Volume Damper: Diameter 20 inches or less, air velocity 1500 fpm or less, and duct static pressure class 2-inch or less. Galvanized steel sleeve with reinforcing beads. Single galvanized steel blade on axle with molded synthetic bearing at each end of axle and locking quadrant on standoff bracket. Basis of design Ruskin MDRS25.

C. Round or Oval Manual Volume Damper: Diameter 48 inches or less, air velocity 4000 fpm or less, and duct static pressure class 10-inch or less. Galvanized steel construction for galvanized steel duct. Type 304 stainless steel construction for type 304 stainless steel or aluminum duct. Type 316 stainless steel construction for type 316 stainless steel duct. Rolled hat channel frame arranged for slip-in mounting. Single blade (or dual blades with center mullion for oval duct over 36 inches wide). Neoprene blade edge seals. Class II leakage rating. Blade mounted on axle with stainless steel sleeve bearing at each end of axle and locking quadrant on standoff bracket. Basis of design Ruskin CDR25 or CDO25.

D. Rectangular Manual Volume Damper: Height 12 inches or less, air velocity 1500 fpm or less, and duct static pressure class 1-inch or less. Galvanized steel sleeve with blade stop. Single galvanized steel blade on axle with molded synthetic bearings and locking quadrant on standoff bracket. Basis of design Ruskin MD25.

E. Rectangular Manual Volume Dampers: Height 5 inches or more, air velocity 1500 fpm or less., and duct static pressure class 3-inch or less. Galvanized steel hat channel frame with mitered and welded corners and blade stop. Flanged for attaching to wall and flangeless for installing in duct. Multiple single-thickness formed galvanized steel blades with opposed blade linkage enclosed in frame. Blades mounted on axles

with molded synthetic bearings. Control shaft extended beyond frame with locking quadrant on standoff bracket. Basis of design Ruskin MD35.

2.4 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Ductmate Industries, Inc.
2. Ward Industries; a brand of Hart & Cooley, Inc.

B. Description: Add-on, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.5 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA 006.

D. Vane Construction: Single wall for vanes up to 48 inches wide and double wall for larger dimensions.

2.6 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA 006. Double wall, rectangular door. Galvanized sheet steel with insulation fill and thickness as indicated for duct pressure class. Butt or piano hinges and cam locks, quantities as indicated in SMACNA 006. Doors airtight and suitable for duct pressure class. Galvanized sheet steel frame with bend-over tabs and foam gaskets. Vision panel where indicated.

B. Pressure Relief Access Door: Door and frame of galvanized sheet steel. Double wall door with insulation fill and metal thickness applicable for duct pressure class. Open outward for positive-pressure duct and inward for negative-pressure duct. Factory set at 3.0-inch to 8.0-inch wg positive or negative. Door retaining device. Neoprene or foam rubber seal.

2.7 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene. Minimum weight 26 oz./sq. yd. Minimum tensile strength 480 lbf/inch in the warp and 360 lbf/inch in the filling. Service temperature range minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone. Minimum weight 24 oz./sq. yd. Tensile strength 530 lbf/inch in the warp and 440 lbf/inch in the filling. Service temperature range minus 50 to plus 250 deg F.

2.8 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories in accordance with manufacturers' instructions.

B. Install duct accessories according to applicable details in SMACNA 006 for metal ducts and in NAIMA AH116 for fibrous-glass ducts.

C. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

D. Compliance with ASHRAE/IESNA 90.1 restricts the use of backdraft dampers, and requires control dampers for certain applications. Install backdraft or control damper (as indicated) at inlet of exhaust fan or in exhaust duct close to exhaust fan unless otherwise indicated.

E. Install volume dampers only in ducts constructed to magnitude 2" pressure class or less. Provide at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

F. Flag all manual volume dampers in ducts concealed above a ceiling with high-visibility tape.

G. Set each damper fully open position before testing, adjusting, and balancing.

H. Install test holes at fan inlets and outlets and elsewhere as indicated.

I. Install access door with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Two-Hand Access: 12 by 12 inches.

2. Head and Hand Access: 18 by 12 inches.
3. Head and Shoulders Access: 24 by 18 inches.
4. Body Access: 30 by 18 inches.
5. Body plus Ladder Access: 30 by 30 inches.
6. Where duct width does not permit door size specified above, one dimension of door size may be reduced to 2 inches less than duct width.

K. Install flexible connectors to connect ducts to equipment. If vibrating equipment is internally isolated from casing, provide rigid duct connections.

L. For fan developing static pressure of 5-inch wg or more, cover flexible connector with loaded vinyl sheet held in place with metal straps.

M. Install duct test hole where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate each damper to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed and that door can open fully.
3. Inspect turning vanes for proper and secure installation.

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SECTION 23 33 46

FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulated flexible ducts.

1.2 SUBMITTALS

A. Action Submittals:

   1. Product Data: For each type of product.
   2. Shop Drawings: For flexible ducts. Include plans showing locations and mounting and attachment details.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA 006 "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Comply with Air Diffusion Council "ADC Flexible Air Duct Test Code FD 72-R1."

D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

   1. Flexmaster U.S.A., Inc.
   2. McGill Airflow LLC.
   3. Thermaflex; a Flex-Tek Group.
   4. Ward Industries; a brand of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   2. Maximum Air Velocity: 4000 fpm.

3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-Value: R6.

C. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Insulation R-Value: R6.

2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

B. Non-Clamp Connectors: Liquid adhesive plus tape.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA006 for metal ducts and in NAIMA AH116 for fibrous-glass ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions or correct misalignments.

D. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

E. Connect flexible ducts to metal ducts with liquid adhesive plus tape or draw bands.

F. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Centerline radius of bends of flexible ducting shall not be less than one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns except as noted elsewhere.

G. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches on center.

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SECTION 23 34 16

CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: For each product.
   1. Backward-inclined centrifugal fans.

1.2 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevation.

B. Operating Limits: Classify according to AMCA 99.

1.3 SUBMITTALS

A. Action Submittals:

   1. Product Data:

      a. Include rated capacities, furnished specialties, and accessories for each fan.
      b. Certified fan performance curves with system operating conditions indicated.
      c. Certified fan sound-power ratings.
      d. Motor ratings and electrical characteristics, plus motor and electrical accessories.
      e. Material thickness and finishes, including color charts.
      f. Dampers, including housings, linkages, and operators.

B. Informational Submittals:

   1. Field quality-control reports.

C. Closeout Submittals:

   1. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

D. Maintenance Material Submittals:

   1. Belts: One spare set for each belt-driven unit.

1.4 QUALITY ASSURANCE

A. AMCA Compliance:

   1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
   2. Operating Limits: Classify according to AMCA 99.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. PennBarry.
4. Twin City Fan & Blower.

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven or direct-driven (as indicated) centrifugal fan consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fan as factory-assembled unit, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

C. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff. Panel joints welded for airtight assembly.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing (if necessary to install fan).
4. Spun inlet cone with flange.
5. Outlet flange.

D. Backward-Inclined Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades fastened to shaft with set screws.
2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, LI0 at 120,000 hours.
3. Roller-Bearing Rating Life: ABMA 11, LI0 at 120,000 hours.

G. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: 1.5.
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
7. Motor Mount: Adjustable for belt tensioning.

H. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Inlet Screens: Grid screen of same material as housing.
5. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
6. Spark-Resistant Construction: AMCA 99.
7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fan.
8. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in another Division 23 Section.

2.3 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301. Factory test fans according to AMCA 300. Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fans and accessories in accordance with manufacturer’s instructions.

B. Install centrifugal fans level and plumb.

C. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

D. Lift and support units with manufacturer's designated lifting or supporting points.

E. Install units with clearances for service and maintenance.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, indirect to drain with pipe sizes matching the drain connection.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect belt-driven fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension where applicable.
6. Provide and verify proper lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
8. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
9. Shut unit down and reconnect automatic temperature-control operators.
10. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 23 34 16

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Action Submittal:

1. Product Data: For each product indicated, include the following:

   a. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   b. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

2. Color Samples for Initial Selection: For each product with factory-applied color finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Titus.
2. Price.
3. Krueger.
4. Hart & Cooley.
5. Metalaire.
6. Nailor Industries Inc.
7. Tuttle & Bailey.

2.2 DIFFUSERS, REGISTERS, AND GRILLES

A. Architectural Ceiling Diffuser:
   1. Material: Steel.
   2. Finish: Baked enamel, white.
   3. Face Size: 24 by 24 inches.
   4. Face Style: Plaque.
   5. Mounting: Lay-In or Surface Mount, refer to schedule.
   6. Accessories: Factory-insulated R-6 foil-backed insulation.

B. Sidewall Supply Grille:
   1. Material: Steel.

2. Finish: Baked enamel, white.
3. Mounting: Surface or Duct Mount.
4. Face Arrangement: Double Deflection.
5. Blades: Adjustable, front blades parallel to long dimension.
6. Blade Spacing: 3/4-inch.
7. Accessories: Opposed Blade Damper.

C. Continuous Slot Diffuser with Pattern Controller:
1. Material: Aluminum.
2. Finish: Baked enamel, white border.
3. Mounting: Ceiling or Sidewall, refer to schedule.
4. Pattern Controller: Adjustable or Fixed, refer to schedule.
5. Slot Width: Refer to schedule.
6. Number of Slots: Refer to schedule
7. Length: Refer to schedule.

D. Exposed Spiral Duct Supply Grille:
1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Mounting: Duct.
4. Face Size: Refer to schedule
5. Face Arrangement: Double Deflection.
6. Blades: Adjustable, parallel to long dimension.
7. Blade Spacing: 3/4-inch.
8. Accessories: Air Scoop Damper.

E. Eggcrate Grille and Register:
1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Face Arrangement: 1/2-by-1/2-by-1/2-inch.
4. Face Size: Refer to schedule.
5. Frame: 1-1/4 inches wide.
6. Mounting: Lay-In or Surface Mount, refer to schedule.
7. Damper (Register Only): Adjustable opposed-blade assembly.

F. Sidewall Return Grille:
1. Material: Steel
2. Finish: Baked enamel, white.
3. Mounting: Surface or Duct Mount.
4. Face Arrangement: 35° Fixed.
5. Blades: Fixed, blades parallel to long dimension.
6. Blade Spacing: 3/4-inch.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. Provide sponge rubber gasket, mounting frame, and concealed fastener mounting on all surface mounted grilles and registers.

E. Paint inside portion on all ductwork and plenums visible behind air device non-specular flat black enamel.

F. Provide additional support for grilles, registers, and diffusers mounted in lay-in ceiling.

G. Provide non-specular flat black steel blank-offs behind all unused portions of linear air devices.

H. Coordinate exact location of diffusers, grilles and registers with area smoke detectors, lights, and electrical devices. Air devices shall not be closer than 3 feet from area smoke detector.

I. Final location of diffusers, registers and grilles shall be from architectural reflected ceiling plans.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 3 713

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SECTION 23 74 33

DEDICATED OUTDOOR-AIR UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes factory-packaged units capable of supplying outdoor air conditioned for room distribution.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product:

    a. Unit dimensions and weight. Include shipping splits and weight by segment. Include shipping and installed weights.
    b. Cabinet material, metal thickness, finishes, insulation, and accessories.
    c. Fans:

        1) Certified fan-performance curves with system operating conditions indicated. Include flow, pressure drop, speed, brake HP, drive losses, and fan efficiency.
        2) Certified fan-sound power ratings.
        3) Fan construction and accessories (including belt guards, plenum fan cages, and piezometer rings).
        4) Motor ratings, electrical characteristics, and motor accessories. Include efficiencies and statement of VFD compatibility.
        5) Vibration isolation and restraint, including thrust restraints.

    d. Certified coil-performance ratings with system operating conditions indicated, tube thickness, fin thickness, and materials.
    e. Dampers, including housings, linkages, operators, and linkage ratings.
    f. Filters with performance characteristics including initial and final pressure drops at rated airflow. Include information on differential pressure gages and filter clips.
    g. Sound ratings for overall unit performance: Radiated sound, discharge air sound and entering air sound.
    h. Pressure drop across each segment of the air handling unit.
    i. Wiring diagrams: Power, signal and control wiring. Differentiate between factory-installed components and wiring and field-installed components and wiring.
    j. Electrical component information, including lights, receptacle, conduit and junction boxes.
    k. Access door construction, including door thickness, door operator type and material, handle locations and hinge information, thermal pane window information and test port locations.
    l. Drain pan construction with invert of drain pan dimensioned from the bottom of unit. Identify drain piping with trap heights detailed.
    m. Airflow measuring probe calibration data.
    n. Test reports on leakage and vibration.
    o. All furnished specialties and accessories.
    p. Installation and startup instructions include fan bearing lubrication schedule and requirements.

B. Informational Submittals:

1. Startup service reports.

2. Sample Warranty: For special warranty.

C. Closeout Submittals:

1. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

D. Maintenance Material Submittals:

1. Furnish additional materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

a. Filters: One set for each unit.
b. Gaskets: One set for each access door.
c. Final Fan Belts and Fan Sheaves: One set for each air-handling unit belt-driven fan sized by the test and balance contractor as required to deliver the necessary airflow through the system accounting for all system losses.
d. Paint: One quart-size can of touch-up paint for the exterior finish of each air handling unit provided.

1.3 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with AHRI 410 for components, construction and rating. Certify coils to AHRI 410.

C. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

D. ASHRAE Compliance: Comply with applicable sections of the following:

1. ASHRAE 52.1.
2. ASHRAE 62.1.
3. ASHRAE 90.1.

1.4 SOURCE QUALITY CONTROL

A. AHRI 430 Certification: Air-handling units and their components shall be factory tested according to AHRI 430 and shall be listed and labeled by AHRI.

B. AHRI 1060 Certification: Air-handling units that include air-to-air energy recovery devices shall be factory tested according to AHRI 1060 and shall be listed and labeled by AHRI.

C. AMCA 301 or AHRI 260: Air-handling unit fan sound ratings shall comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data," or AHRI 260, "Sound Rating of Ducted Air Moving and Conditioning Equipment."

D. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

E. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

F. Refrigerant Coils: Factory tested to minimum 450-psig internal pressure and to minimum 300-psig internal pressure while underwater, according to AHRI 410 and ASHRAE 33.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect, pack, and secure loose-shipped items within the air-handling units. Include detailed packing list of loose-shipped items, including illustrations and instructions.

B. Protect, pack and secure control devices, motor control devices, and other electronic equipment. Do not store electronic equipment in wet or damp areas even when they are sealed and secured.

C. Enclose and protect control panels, electronic devices, and variable frequency drives. Do not store equipment in wet or damp areas even when they are sealed and secured.

D. Seal openings to protect against damage during shipping, handling, and storage.

E. Wrap indoor units with a tight sealing membrane. Wrapping membrane shall cover entire AHU during shipping and storage. Cover equipment, regardless of size or shape. Alternatively, AHU must be tarped for shipment and storage.

F. Wrap equipment, including electrical components, for protection against rain, snow, wind, dirt, sun fading, road salt/chemicals, rust, and corrosion. Keep equipment clean and dry.

G. Tarp outdoor units to protect against rain and road debris during shipping.

H. Clearly mark AHU sections with unit tag number, segment sequence number, and direction of airflow. Securely affix safety-warning labels.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Daikin.

2.2 GENERAL DESCRIPTION

A. Unit performance and electrical characteristics shall be per the job schedule.

B. Configuration: Fabricate as detailed on prints and drawings:
1. Return plenum / economizer section
2. Filter section
3. Cooling coil section

4. Supply fan section
5. Gas heating section.
6. Condensing unit section

C. The complete unit shall be cETLus listed.

D. The unit shall be ASHRAE 90.1-2016 compliant and labeled.

E. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-410 Refrigerant and oil.

F. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.

G. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

H. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.

2.3 CABINET, CASING, AND FRAME

A. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 2" thick with an R-value of 13.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.

B. Exterior surfaces shall be constructed of pre-painted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat of a neutral beige color. Finished panel surfaces to withstand a minimum 1000-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance.

C. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.

D. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

2.4 OUTDOOR/RETURN AIR SECTION

A. Unit shall be provided with a 100% outdoor air hood. The 100% outdoor air hood shall allow outdoor air to enter from the back of the unit, at the draw-through filter section. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include a bird screen to prevent infiltration of foreign materials and a rain lip to drain water away from the entering air stream.

B. Low leak dampers shall be provided. Damper blades shall be fully gasketed and side sealed and arranged vertically in the hood. Damper leakage shall be less than 1.5 CFM/Sq. Ft. of damper area at 1.0 inch static pressure differential. Leakage rate to be tested in accordance with AMCA Standard 500. Damper blades

shall be operated from multiple sets of linkages mounted on the leaving face of the dampers. Control of the dampers shall be from a factory installed actuator.

C. Control of the outdoor dampers shall be by a factory installed actuator. Damper actuator shall be of the modulating type. Damper to open when when supply fan starts, and close when supply fan stops.

2.5 ENERGY RECOVERY

A. The rooftop unit shall be provided with an AHRI certified rotary wheel air-to-air heat exchanger in a cassette frame complete with seals, drive motor and drive belt. The energy recovery wheel shall be an integral part of the rooftop unit with unitary construction and does not require field assembly. Bolt-on energy recovery units that require field assembly and section to section gasketing and sealing are not acceptable.

B. The wheel capacity, air pressure drop and effectiveness shall be AHRI certified per AHRI Standard 1060. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Heat Exchangers For Energy Recovery Ventilation Equipment.

C. The rooftop unit shall be designed with a track so the entire energy recovery wheel cassette can slide out from the rooftop unit to facilitate cleaning.

D. The unit shall have 2” Merv 7 filters for the outdoor air before the wheel to help keep the wheel clean and reduce maintenance. Filter access shall be by a hinged access door with ¼ turn latches.

E. The matrix design shall have channels to reduce cross contamination between the outdoor air and the exhaust air. The layers shall be effectively captured in aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belt(s) of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.

F. The total energy recovery wheel shall be coated with silica gel desiccant permanently bonded without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.

G. Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning.

H. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel. Wheels shall be connected to the shaft by means of taper lock hubs.

I. The exhaust air fan shall be a direct drive SWSI plenum fan. The exhaust fan shall be sized for the airflow requirements per the construction schedule. The unit controller shall control the exhaust fan to maintain building pressure. A VFD shall be provided for the exhaust fan motor or the exhaust fan motor shall be an ECM motor.The rooftop unit shall have single point electrical power connection and shall be ETL listed.

J. The control of the energy recovery wheel shall be an integral part of the rooftop unit’s DDC controller. The DDC controller shall have visibility of the outdoor air temperature, leaving wheel temperature, return air temperature, and exhaust air temperature. These temperatures shall be displayed at the rooftop units DDC controller LCD display. All of these temperatures shall be made available through the BACnet interface.

K. The rooftop unit DDC controller shall provide frost control for the energy recovery wheel. When a frost condition is encountered the unit controller shall stop the wheel. When in the frost control mode the wheel shall be jogged periodically and not be allowed to stay in the stationary position.

2.6 EXHAUST FAN

A. Exhaust fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The exhaust fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.

B. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

C. The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The field shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor.

2.7 FILTERS

A. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2” prefilter and a 4” final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2” MERV 8 construction filters. The contractor shall furnish and install, at building occupancy, the final set of filters per the contract documents.

2.8 COOLING COIL

A. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.

B. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.

C. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.

D. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.

E. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

2.9 HOT GAS REHEAT

A. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser

B. Hot gas reheat coil shall be a Micro Channel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.

C. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.

D. Each coil shall be factory leak tested with high-pressure air under water.

2.10 SUPPLY FAN

A. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additonal maintenance.

B. All fan assemblies shall employ solid steel fan shafts. Heavy-duty pillow block type, self-aligning, grease lubricated ball bearings shall be used. Bearings shall be sized to provide a L-50 life at 250,000 hours. The entire fan assembly shall be isolated from the fan bulkhead with a flexible collar and mounted on 1” spring isolators.

C. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.

D. Supply fan and motor assembly combinations larger than 8 hp or 22” diameter shall be internally isolated on 1” deflection, spring isolators and include removable shipping tie downs.

E. The motor shall be T Frame and open drip proof. Overload protection and speed control is provided by the factory installed VFD and rooftop unit controller. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

F. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

2.11 VARIABLE AIR VOLUME CONTROL

A. An electronic variable frequency drive shall be provided for the supply air fan. Each drive shall be factory installed out of the air stream in a conditioned cabinet. Drives shall meet UL Standard 95-5V. The completed unit assembly shall be listed by a recognized safety agency, such as ETL. Drives are to be accessible through a hinged door assembly. Mounting arrangements that expose drives to high temperature unfiltered ambient air are not acceptable.

B. The unit manufacturer shall install all power and control wiring.

C. The supply air fan drive output shall be controlled by the factory installed main unit control system and drive status and operating speed shall be monitored and displayed at the main unit control panel.

2.12 HEATING SECTION

A. The rooftop unit shall include a natural gas heating section. The gas furnace design shall be one natural gas fired heating module factory installed downstream of the supply air fan in the heat section. The heating module shall be a tubular design with in-shot gas burners.

B. The module shall be complete with furnace controller and control valve capable of 12:1 modulating operation.

C. The heat exchanger tubes shall be constructed of stainless steel.

D. The module shall have an induced draft fan that will maintain a negative pressure in the heat exchanger tubes for the removal of the flue gases.

E. Each burner module shall have two flame roll-out safety protection switches and a high temperature limit switch that will shut the gas valve off upon detection of improper burner manifold operation. The induced draft fan shall have an airflow safety switch that will prevent the heating module from turning on in the event of no airflow in the flue chamber.

F. The factory-installed DDC unit control system shall control the gas heat module. Field installed heating modules shall require a field ETL certification. The manufacturer's rooftop unit ETL certification shall cover the complete unit including the gas heating modules.

2.13 CONDENSING SECTION

A. Outdoor coils shall be cast aluminum, micro-channel coils. Plate fins shall be protected and brazed between adjoining flat tubes such that they shall not extend outside the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.

B. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 0~120°F. Mechanical cooling shall be provided to 0º F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

C. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material.

D. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and low oil safety protection.

E. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.

F. Each circuit shall be dehydrated and factory charged with R-410A Refrigerant and oil.

2.14 ELECTRICAL

A. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply

fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

B. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.

2.15 CONTROLS

A. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.

B. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate stand alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

C. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.

D. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.

E. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.

F. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:
   1. Return air temperature.
   2. Discharge air temperature.
   3. Outdoor air temperature.
   4. Space air temperature.
   5. Outdoor enthalpy, high/low.
   6. Compressor suction temperature and pressure
   7. Compressor head pressure and temperature
   8. Expansion valve position
   9. Condenser fan speed
   10. Inverter compressor speed
   11. Dirty filter indication.
   12. Airflow verification.
   13. Cooling status.
   14. Control temperature (Changeover).
   15. VAV box output status.
   16. Cooling status/capacity.
   17. Unit status.

18. All time schedules.
19. Active alarms with time and date.
20. Previous alarms with time and date.
21. Optimal start
22. Supply fan and exhaust fan speed.
23. System operating hours.
    a. Fan
    b. Exhaust fan
    c. Cooling
    d. Inndividual compressor
    e. Heating
    f. Economizer
    g. Tenant override

G. The user interaction with the keypad shall provide the following:
1. Controls mode
    a. Off manual
    b. Auto
    c. Heat/Cool
    d. Cool only
    e. Heat only
    f. Fan only
2. Occupancy mode
    a. Auto
    b. Occupied
    c. Unoccupied
    d. Tenant override
3. Unit operation changeover control
    a. Return air temperature
    b. Space temperature
    c. Network signal
4. Cooling and heating change-over temperature with deadband
5. Cooling discharge air temperature (DAT)
6. Supply reset options
    a. Return air temperature
    b. Outdoor air temperature
    c. Space temperature
    d. Airflow (VAV)
    e. Network signal
    f. External (0-10 vdc)
    g. External (0-20 mA)
7. Temperature alarm limits
    a. High supply air temperature
    b. Low supply air temperature
    c. High return air temperature
8. Lockout control for compressors.
9. Compressor interstage timers
10. Night setback and setup space temperature.
11. Building static pressure.
12. Economizer changeover
    a. Enthalpy
    b. Drybulb temperature
13. Currently time and date
14. Tenant override time
15. Occupied/unoccupied time schedule
16. One event schedule
17. Holiday dates and duration
18. Adjustable set points
19. Service mode
    a. Timers normal (all time delays normal)
    b. Timers fast (all time delays 20 sec)

H. If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include:
   1. Zone sensor with tenant override switch
   2. Zone sensor with tenant override switch plus heating and cooling set point adjustment. (Space Comfort Control systems only)

I. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:
   1. Airflow
   2. Outside air temperature
   3. Space temperature
   4. Return air temperature
   5. External signal of 1-5 vdc
   6. External signal of 0-20 mA
   7. Network signal

2.16 ROOF CURB

A. A prefabricated heavy gauge galvanized steel, mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of 14" high and include a nominal 2" x 4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Comply with manufacture’s start-up checklist.

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."

   1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
   2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7.

3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.

C. Restrained Curb Support: Install restrained vibration isolation roof-curb rails on roof structure according to "The NRCA Roofing Manual."

D. Equipment Mounting:

1. Install air units on cast-in-place concrete equipment bases.
2. Comply with requirements for vibration isolation and seismic control devices specified in Division 23.

E. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

F. Install 3000-psi, compressive-strength (28-day) concrete base inside roof curb, 4 inches thick. Concrete and reinforcement are specified with concrete.

G. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."

H. Install separate devices furnished by manufacturer and not factory installed.

I. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

J. Install drain pipes from unit drain pans to sanitary drain.

1. Drain Piping: Drawn-temper copper water tubing complying with ASTM B 88, Type M, with soldered joints.
2. Pipe Size: Same size as condensate drain pan connection.

3.3 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance.

B. Gas Piping Connections:

1. Comply with requirements in Division 22.
2. Connect gas piping to furnace, full size of gas train inlet, and connect with sufficient clearance for burner removal and service.

C. Duct Connections:

1. Comply with requirements in other Division 23 sections.
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Division 23.

D. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

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SECTION 23 81 29

VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes complete variable refrigerant flow (VRF) HVAC systems.

1.2 DEFINITIONS

A. Air-Conditioning System Operation: System capable of operation with all zones in cooling only.

B. Heat-Pump System Operation: System capable of operation with all zones in either heating or cooling, but not with simultaneous heating and cooling zones that transfer heat between zones.

C. Heat Recovery System Operation: System capable of operation with simultaneous heating and cooling zones that transfer heat between zones.

D. HRCU: Heat Recovery Control Unit. HRCUs are used in heat recovery VRF HVAC systems to manage and control refrigerant between indoor units to provide simultaneous heating and cooling zones. "Heat Recovery Control Unit" is the term used by ASHRAE for what different manufacturers term as branch circuit controller, branch selector box, changeover box, flow selector unit, mode change unit, and other such terms.

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product include:

    a. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units and for HRCUs.
    b. Rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
    c. Operating performance at design conditions and at extreme maximum and minimum outdoor ambient conditions.
    d. Description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
    e. System operating sequence of operation in narrative form for each unique indoor- and outdoor-unit and HRCU control.
    f. Description of control software features.
    g. Total refrigerant required, and a comprehensive breakdown of refrigerant required by each system installed.
    h. Refrigerant type and data sheets showing compliance with requirements indicated.
    i. System design software information.
    j. Indication of location and type of service access.

2. Shop Drawings: For VRF HVAC systems.

    a. Include plans, elevations, sections, and mounting attachment details.

b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
c. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
d. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.
e. Include diagrams for power, signal, and control wiring.

3. Samples for Initial Selection: For fully and partially exposed indoor units with factory finishes viewable by occupants. Include a sample for each unique finish with unit identification, detailed description of application, and cross-referenced floor plans showing locations.

B. Informational Submittals:

1. Qualification Data:

a. For Installer: Certificate from VRF HVAC system manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation. Retain copies of Installer certificates on-site and make available on request.
b. For VRF HVAC system manufacturer.
c. For VRF HVAC system provider.

2. Source quality-control reports.
3. Field quality-control reports.
4. Sample Warranties: For manufacturer's warranties.

C. Closeout Submittals:

1. Operation and Maintenance Data: For VRF HVAC systems to include in emergency, operation, and maintenance manuals.
2. Software and Firmware Operational Documentation:

a. Software operating and upgrade manuals.
b. Program Software Backup: On CD or DVD, USB media, or approved cloud storage platform, complete with data files.
c. Device address list.
d. Printout of software application and graphic screens.

3. Extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

a. Filters: One set for each unit.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Nationally recognized manufacturer of VRF HVAC systems and products.
2. Shipped VRF HVAC systems with similar requirements to those indicated for a continuous period of five years within time of bid.
3. VRF HVAC systems and products that have been successfully tested and in use in at least five completed projects.

4. Having complete published catalog literature, installation, and operation and maintenance manuals for all products intended for use.
5. ISO Compliance: System equipment and components furnished by VRF HVAC system manufacturer shall be manufactured in an ISO 9001 and ISO 14001 facility.

B. Factory-Authorized Service Representative Qualifications:

1. Authorized representative of, and trained by, VRF HVAC system manufacturer.
2. Demonstrated experience on projects of similar complexity, scope, and value. Each person assigned to Project shall have demonstrated experience.
3. Service and maintenance staff assigned to support Project during warranty period.
4. Product parts inventory to support ongoing system operation for a period of not less than five years after Substantial Completion.

C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.

1. Each Installer certified by manufacturer for proper installation of systems, including, but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
2. Installer certification shall be valid and current for duration of Project.
3. Retain copies of Installer certificates on-site and make available on request.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. AHRI Compliance: System and equipment performance certified according to AHRI 1230 and products listed in AHRI directory.

F. ASHRAE Compliance: Comply with applicable requirements in:

1. ASHRAE 15.
2. ASHRAE 62.1.
3. ASHRAE/IES 90.1.
4. ASHRAE 135: For control network protocol with remote communication.

G. UL Compliance: Comply with UL 1995.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in a clean and dry place.

B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.

C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.

D. Protect products from weather, dirt, dust, water, construction debris, and physical damage. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remover coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit. Remove and replace products that are wet, moisture damaged, or mold damaged.

E. Replace installed products damaged during construction.

F. Protect equipment from electrical damage. Replace equipment suffering electrical damage.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressors: 10 years from date of Substantial Completion.
b. For Parts, Including Controls: 10 years from date of Substantial Completion.
c. For Labor: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 HVAC SYSTEM DESCRIPTION

A. The variable capacity heat recovery air conditioning system shall be a system as specified.

B. The system shall consist of multiple evaporators, branch selector boxes, REFNET joints and headers, a three-pipe refrigeration distribution system using PID control and variable refrigerant flow condenser unit.

C. The condenser shall be a direct expansion (DX), air-cooled heat recovery, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant.

D. The condensing unit may connect an indoor evaporator nominal capacity up to 200% of the condensing unit nominal capacity. All zones are each capable of operating separately with individual temperature control.

E. A dedicated hot gas pipe shall be required to ensure optimum heating operation performance.
1. Two-pipe, heat recovery systems utilizing a lower temperature mixed liquid/gas refrigerant to perform heat recovery are not acceptable due to reduced heating capabilities.

F. The condensing unit shall be able to connect to indoor unit models listed in drawings and shall range in capacity from 5,800 Btu/h to 54,000 Btu/h in accordance with manufacturer’s engineering data book detailing each available indoor unit.
1. The indoor units shall be connected to the condensing unit utilizing REFNET specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable for a variable refrigerant system.

G. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with each branch of the cool/heat selector box. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Controller, an Intelligent Manager or a BMS interface.

H. Branch selector boxes:
1. The branch selector boxes shall have the capacity to control up to 290 MBH (cooling) downstream of the branch selector box.
2. Each branch of the branch selector box shall consist of three electronic expansion valves, refrigerant control piping and electronics to facilitate communications between the box and main processor and between the box and indoor units.
3. The branch selector box shall control the operational mode of the subordinate indoor units. The use of three EEV’s ensures continuous heating during defrost (multiple condenser systems), no heating impact during changeover and reduced sound levels.
4. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.

2.2 OUTDOOR UNIT SYSTEM DESCRIPTION

A. Stable Operation – System shall provide stable inverter operation at varied ambient conditions.

B. No Drain Pan Heater – System shall be capable of heating operation without the need for a drain pan heater. If alternate manufacturer is chosen, an additional drain pan heater shall be provided by the manufacturer.

C. Auto Changeover – System shall, below the field selected outdoor ambient temperature provide signal to initiate auxiliary or back up heat.

D. Advanced Zoning - A single system shall provide for up to 64 zones.

E. Independent Control - Each indoor unit shall use a dedicated electronic expansion valve with up to 2000 positions for independent control.

F. VFD Inverter Control and Variable Refrigerant Temperature - Each condensing unit shall use high efficiency, variable speed all “inverter” based flash vapor injection compressor(s) coupled with inverter fan motors to optimize part load performance. The system capacity and refrigerant temperatures shall be modulated automatically to set suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads. The control will be automatic and customizable depending on load and weather conditions.
   1. Indoor shall use PID to control superheat to deliver a comfortable room temperature condition and optimize efficiency.

G. Configurator software - Each system shall be available with configurator software package to allow for remote configuration of operational settings and also for assessment of operational data and error codes.
   1. If this software is not provided by an alternate manufacturer, for each individual outdoor unit the contractor shall do the settings manually and keep detailed records for future maintenance purposes.

H. Defrost Heating – Multiple condenser Variable Refrigerant Flow systems shall maintain continuous heating during defrost operation. Reverse cycle (cooling mode) defrost operation shall not be permitted due to the potential reduction in space temperature.

I. Oil Return Heating – Variable Refrigerant Flow systems shall maintain continuous heating during oil return operation. Reverse cycle (cooling mode) oil return during heating operation shall not be permitted due to the potential reduction in space temperature.

J. Low Ambient Cooling - Each system shall be capable of low ambient cooling operation to -4°FDB (-20°CDB).

K. Independent Control - Each indoor unit shall use a dedicated electronic expansion valve for independent control.

L. Flexible Design –
   1. Systems shall be capable of up to 540ft of linear piping between the condensing unit and furthest located indoor unit.
   2. Systems shall be capable of up to 3,280ft total “one-way” piping in the piping network.
   3. Systems shall have a vertical (height) separation of up to 295ft between the condensing unit and the indoor units.
   4. Systems shall be capable of up to 295ft from the first REFNET / branch point.
   5. The condensing unit shall have the ability to connect an indoor unit evaporator capacity of up to 200% of the condensing unit nominal capacity.
   6. Systems shall be capable of 98ft vertical separation between indoor units.
   7. Condensing units shall be supported with a fan motor ESP up to 0.32” WG as standard to allow connection of discharge ductwork and to prevent discharge air short circuiting.

M. Oil return – Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle.

N. Simple wiring – Systems shall use 16/18 AWG, 2 wire, stranded, non-shielded and non-polarized daisy chain control wiring.

O. Each condensing unit shall include a multi-functional digital display that can provide system operation status such as operating refrigerant temperatures, pressures, outdoor electronic expansion valve opening and compressor operation time.

P. Each condensing unit shall include a service window that can provide easy access to system field settings and operation status without completely removing the condensing unit panel.

Q. Advanced diagnostics – Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.

R. Each condensing unit shall incorporate contacts for electrical demand shedding with optional 3 stage demand control with 12 customizable demand settings.

S. Advanced controls – Each system shall have at least one remote controller capable of controlling up to 16 indoor units.

T. Each system shall be capable of integrating with open protocol BACnet, LonWorks and Modbus building management systems.

U. Low sound levels - Each system shall use indoor and condensing units with quiet operation as low as 27 dB(A).

2.3 OUTDOOR UNIT REQUIREMENTS

A. Performance Conditions:
1. Cooling: Indoor temperature of 80°FDB (26.7°CDB), 67°FWB (19.5°CWB) and outdoor temperature of 95°FDB (35°CDB).
2. Heating: Indoor temperature of 70°FDB (21.1°CDB) and outdoor temperature of 47°FDB (8.3°CDB), 43°FWB (6.1°CDB).
3. Equivalent piping length: 25ft

B. Cooling or Cooling Dominant Operation:
1. The standard operating range in cooling or cooling dominant simultaneous cooling/heating will be 23°FDB (-5°CDB) ~ 122°FDB (50°CDB).
2. Cooling mode indoor room temperature range will be 57-77°FWB (13.8 - 25°CWB).
3. Each system as standard shall be capable of onsite reprogramming to allow low ambient cooling operation down to -4°FDB (-20°CDB).

C. Heating or Heating Dominant Operation:
1. The standard operating range in heating or heating dominant simultaneous cooling/heating will be -13° – 61°FWB (-25 – 16°CWB).
   a. If an alternate equipment manufacturer is selected, the mechanical contractor shall provide, at their own risk and cost, all additional material and labor to meet low ambient operating condition and performance
2. Heating mode indoor room temperature range will be 59°FDB - 80°F DB (15°CDB – 26.7°CDB).

2.4 WIRING:

A. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.

B. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation.

C. The control wiring maximum lengths shall be as shown below:

	CONDENSER TO INDOOR UNIT	CONDENSER TO CENTRAL CONTROLLER	INDOOR UNIT TO REMOTE CONTROL
CONTROL WIRING LENGTH	6,560ft	3,280ft	1640 ft
WIRE TYPE	16/18 AWG, 2 wire, non-polarity, non-shielded, stranded		

2.5 REFRIGERANT PIPING:

A. The system shall be capable of refrigerant piping up to 540ft actual or 623ft equivalent from the condensing unit to the furthest indoor unit, a total combined liquid line length of 3,280ft of piping between the condensing and indoor units with 295 feet maximum vertical difference, without any oil traps or additional components.

B. REFNET piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance.
   1. T style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

2.6 OUTDOOR, AIR-SOURCE HEAT RECOVERY UNITS

A. GENERAL:
   1. The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls.
   2. The refrigeration circuit of the condensing unit shall consist of inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver and suction accumulator.
   3. High/Low pressure gas line, liquid and suction lines must be individually insulated between the condensing and indoor units.
   4. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
   5. The connection ratio of indoor units to condensing unit shall be permitted up to 200% of nominal capacity.
   6. Each condensing system shall be able to support the connection of up to 64 indoor units dependent on the model of the condensing unit.
   7. The sound pressure level standard shall be that value as listed in the engineering manual for the specified models at 3 feet from the front of the unit. The condensing unit shall be capable of operating automatically at further reduced noise during night time or via an external input.
   8. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
   9. The condensing unit shall be modular in design and should allow for side-by-side installation.
   10. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
   11. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
   12. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation. Each system shall maintain continuous heating during oil return operation.
   13. The condensing unit shall be capable of heating operation at -13°F wet bulb ambient temperature without additional low ambient controls or an auxiliary heat source.
   14. The multiple condenser systems shall continue to provide heat to the indoor units in heating operation while in the defrost mode.

B. UNIT CABINET:
   1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed galvanized steel panels coated with a baked enamel finish.

C. FAN:
1. The condensing unit shall consist of one or more propeller type, direct-drive 600W fan motors that have multiple speed operation via a DC (digitally commutating) inverter.
2. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.
3. The condensing unit shall have configurable settings for intermittent fan operation to help minimize snow accumulation on fan blades when the system is off.
4. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
5. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

D. SOUND:
1. Nominal sound pressure levels shall be as shown below.

MODEL NUMBER	SOUND PRESSURE LEVEL dB(A)
REYQ432XAYD*	70

2. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature. Operation sound level shall be selectable from 3 steps.

E. CONDENSER COIL:
1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.
4. The fins shall be coated with an anti-corrosion hydrophilic blue coating as standard from factory with a salt spray test rating of 1000hr per ASTM B117 test standards.
5. The outdoor coil shall have three-circuit heat exchanger design eliminating the need for a drain pan heater. The lower part of the coil shall be used for inverter cooling and be on or off during operation enhancing the defrost operation.
    a. An alternate manufacturer must provide a drain pan heater to enable adequate defrosting of the unit in defrost operation.
6. The condensing unit shall be factory equipped with condenser coil guards on all sides.

F. COMPRESSOR:
1. The inverter Flash Vapor injection scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.
    a. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value.
        1) Non –inverter-driven compressors, which may cause starting motor current to exceed the nominal motor current (RLA) and require larger wire sizing, shall not be allowed.
2. The inverter driven compressors in the condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll “K-type”.
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type.
    a. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The capacity control range shall be as low as 3% to 100%.
5. The compressor’s motor shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.
6. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Oil separators shall be standard with the equipment together with an intelligent oil management system.

8. The compressor shall be mounted on vibration dampening rubber grommets to minimize the transmission of vibration, eliminating the standard need for external spring isolation.
9. In the event of compressor failure, the remaining compressors, if applicable, shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be manually activated to specifically address this condition for single module and manifold systems.
10. In the case of multiple condenser modules, combined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours. When connected to a central control system sequential start is activated for all system on each DIII network.

2.7 BRANCH SELCTOR UNITS

A. GENERAL:
1. The branch selector boxes shall be designed specifically for use with the series of heat recovery system components scheduled.
   a. The selector boxes shall be factory assembled, wired, and piped.
   b. The branch controllers must be run tested at the factory.
   c. The selector boxes must be mounted indoors.
   d. When simultaneously heating and cooling, the units in heating mode shall energize their subcooling electronic expansion valve.
   e. The number of connectable indoor units shall be in accordance with manufacturer.

B. UNIT CABINET
1. These units shall have a galvanized steel plate casing.
2. Each cabinet shall house 3 electronic expansion valves for refrigerant control per branch.
3. The cabinet shall contain one subcooling heat exchanger per branch.
4. The unit shall have sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene.
5. Nominal sound pressure levels must be measured and published on the submittals by the manufacturer.
6. REFRIGERANT VALVES:
   a. The unit shall be furnished with 3 electronic expansion valves per branch to control the direction of refrigerant flow. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.
   b. The refrigerant connections must be of the braze type.
   c. In multi-port units, each port shall have its own electronic expansion valves. If common expansion/solenoid valves are used, redundancy must be provided.
   d. Multiple indoor units may be connected to a branch selector box with the use of a REFNET joint provided they are within the capacity range of the branch selector.
7. CONDENSTATE REMOVAL:
   a. The unit shall not require provisions for condensate removal. A safety device or secondary drain pan shall be installed by the mechanical contractor to comply with the applicable mechanical code, if an alternate manufacturer is selected.
8. ELECTRICAL:
   a. The unit shall be capable of operation within the limits of 187 volts to 255 volts.
   b. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

2.8 INDOOR, CASSETTE, CEILING, MOUNTED UNITS

A. General: Shall be a round flow ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, direct drive DC (ECM) type fan, for installation into the ceiling cavity equipped with an air panel grill. It shall be available in capacities from 7,500 Btu/h to 48,000 Btu/h. It shall be a round flow air distribution type, fresh white, impact resistant decoration panel, or optional self-cleaning filter panel. The supply air is distributed via four individually motorized louvers. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and

surface temperature sensor. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. The indoor units sound pressure shall range from 30 dB(A) to 45 dB(A) at High speed measured at 5 feet below the unit.

B. Indoor Unit:
1. The unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. The round flow supply air flow can be field modified to 23 different airflow patterns to accommodate various installation configurations including corner installations.
5. Return air shall be through the concentric panel, which includes a resin net, mold resistant, antibacterial filter.
6. The indoor units shall be equipped with a condensate pan with antibacterial treatment and condensate pump. The condensate pump provides up to 33-1/2” of lift from bottom of unit to top of drain piping and has a built in safety shutoff and alarm.
7. The indoor units shall be equipped with a return air thermistor.
8. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
9. The voltage range will be 253 volts maximum and 187 volts minimum.
10. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and surface temperature sensor.
11. Supplied air shall be directed automatically by four individually controlled louvers.

C. Unit Cabinet:
1. The cabinet shall be space saving and shall be located into the ceiling.
2. Four auto-adjusted louvers shall be available to choose, which include standard, draft prevention and ceiling stain prevention.
3. The airflow of the unit shall have the ability to shut down outlets with multiple patterns allowing for simpler installation in irregular spaces.
4. A branch duct knockout shall exist for branch ducting of supply air.
5. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

D. Fan:
1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 0.08 to 0.16 HP.
3. The airflow rate shall be available in three manual settings.
4. The DC fan shall be able to automatically adjust the fan speed in 5 speeds based on the space load.
5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings to allow operation with the high efficiency air filter options.
6. The fan motor shall be thermally protected.

E. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin and antibacterial treatment.
2. Optional high efficiency disposable air filters shall be available.
3. Optional Self-Cleaning Filter Panel, which performs automatic filter cleaning up to once a day, with dust collection box that indicates when to be emptied.

F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 2, or 3-row cross fin copper evaporator coil with up to 21 FPI design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1 -1/4 inch outside diameter PVC.
5. A condensate pan with antibacterial treatment shall be located under the coil.
6. A thermistor will be located on the liquid and gas line.

G. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:
1. The unit shall have controls provided by manufacturer to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.

2.9 INDOOR, CONCEALED, CEILING-MOUNTED UNITS FOR DUCTING

A. General: Shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, direct-drive DC (ECM) type fan with auto CFM adjustment at commissioning, for installation into the ceiling cavity. It is constructed of a galvanized steel casing. It shall be available in capacities from 7,500 Btu/h to 48,000 Btu/h. It shall be a horizontal discharge air with horizontal return air configuration. All models feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. Included as standard equipment, a condensate drain pan and drain pump kit that pumps to 18-3/8” from the drain pipe opening. The indoor units sound pressure shall range from 29 dB(A) to 43 dB(A) at low speed measured 5 feet below the ducted unit.

B. Indoor Unit:
1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall be equipment with automatically adjusting external static pressure logic that is selectable during commissioning. This adjusts the airflow based on the installed external static pressure.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 18-3/8” of lift from the center of the drain outlet and has a built in safety shutoff and alarm.
5. The indoor units shall be equipped with a return air thermistor.
6. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
7. The voltage range will be 253 volts maximum and 187 volts minimum.

C. Unit Cabinet:
1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

D. Fan:
1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
2. The unit shall be equipment with automatically adjusting external static pressure logic selectable during commissioning.
3. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range of 0.12 to 0.47 HP respectively.
4. The airflow rate shall be available in three settings.
5. The fan motor shall be thermally protected.
6. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.

E. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 3 row cross fin copper evaporator coil with 15 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1-1/4” outside diameter PVC.
5. A condensate pan shall be located under the coil.
6. A condensate pump with an 18-3/8” lift shall be located below the coil in the condensate pan with a built in safety alarm.
7. A thermistor will be located on the liquid and gas line.

F. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

G. Control:
1. The unit shall have controls provided by the manufacturer to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

2.10 SYSTEM CONTROLS

A. Navigation (NAV) Remote Controller
1. The NAV Remote Controller can provide control for all VRV indoor units. The remote controller wiring consist of a non-polar two-wire connection to the indoor unit at terminals P1/P2. The NAV Remote Controller is wall mounted and can be adjusted to maintain the optimal operation of the connected indoor unit(s). The NAV Remote Controller does not need to be addressed.
2. Basic Operation:
    a. Capable of controlling a group of up to 16 indoor units.
    b. Controller shall control the following group operations:
        1) On/Off, Operation Mode (Cool, Heat, Fan, Dry and Auto* (*with VRV Heat Recovery & Heat Pump Systems))
            a) Configure only the essential modes to be selectable – remove unnecessary mode selection(s) from display
        2) Independent Cooling and Heating setpoints in the occupied mode
            a) Dual setpoints (individual Cool and Heat setpoints with minimum setpoint differential 0 – 8oF default 2oF (1oC)) or Single setpoint

c. Independent Cooling Setup and Heating Setback setpoints in the unoccupied mode
d. Fan Speed
e. Airflow direction (dependent on indoor unit type).
f. The controller shall be able to limit the user adjustable setpoint ranges individually for cooling and heating in the occupied period
g. Function button lockout (On/Off, Mode, Fan Speed, Up/Down, Left, Right Arrows)
h. Optional Controller Face Decal (BRC1E72RM, BRC1E72RF, BRC1E72RMF, BRC1E72RM2, BRC1E72RF2, BRC1E72RMF2) to hide unnecessary (locked out) buttons
i. Indoor Unit group assignment
j. Filter indicator
   1) Filter service indicator displayed after 100 or 2500 (default) hours of run time configurable via field setting
k. Clock (12/24 hour) and Day display
l. Automatic adjustment for Day Light Savings Time (DST)
   1) Set changeover period (second Sunday in March / first Sunday in November)

B. Intelligent Touch Manager (iTM)
1. Capable of controlling by Area(s) or Group(s)
2. Controller shall control the following group operations:
3. On/Off
4. Operation Mode (Cool, Heat, Fan, Dry, and Auto)
5. Independent Cool and Heat dual Setpoints or single Setpoint for current mode in the occupied period
6. Controller shall be able to limit the user adjustable setpoint ranges individually for cooling and heating based upon the Area or Group configurations
7. Independent Setup (Cooling) and Setback (Heating) setpoints in the unoccupied mode adjustable to 50 - 95^0F
8. Setup and Setback setpoints can only be set outside of the occupied setpoint range
9. The Setup and Setback setpoints will automatically maintain a 2^oF fixed differential from the highest possible occupied setpoints
10. The recovery differential shall be 4^0F (default) and adjustable between 2 – 10^0F
11. Settings shall be applied based upon the Area or Group configurations
12. Fan Speed
13. Up to 3 speeds (dependent upon indoor unit type)
14. Airflow direction (dependent upon indoor unit type)
15. 5 fixed positions or oscillating
16. Remote controller permit/prohibit of On/Off, Mode, and Setpoint
17. Lock out setting for Intelligent Touch Manager display
18. Indoor unit Group/Area assignment
19. Capable of providing battery backup power for the clock at least 1 year when no AC power is applied.
20. The battery can last at least 13 years when AC power is applied
21. Settings stored in non-volatile memory

C. BACnet Server Gateway Option
1. The iTM BACnet Server Gateway Option shall be capable of making the intelligent Touch Manager work as a BACnet gateway using the BACnet/IP protocol. The iTM BACnet Server Gateway Option shall be capable of exposing indoor unit management points and indoor/outdoor unit operation data as BACnet objects to the BMS. The iTM BACnet Server/Gateway Option shall be capable of allowing the BMS to monitor and/or control indoor units and outdoor units via BACnet objects.
2. The iTM BACnet Server Gateway Option shall support VRV, SkyAir, Outdoor Air Processing Unit, Mini-Split system with use of KRP928, and FFQ indoor unit for Multi-split system.
3. The iTM BACnet Server Gateway Option shall support operation data for VRV IDUs only (requires Airnet addressing)
4. The iTM BACnet Server Gateway Option shall support operation data for the following VRV IV outdoor units: RXYQ_TATJU, RXYQ_TAYDU, REYQ_TATJU, REYQ_TAYDU(requires Airnet addressing).
5. Functions:
   a. The iTM BACnet Server Gateway Option shall be capable of supporting Change of Value (COV) notification.

b. The iTM BACnet Server Gateway Option shall communicate to BMS using port number 47808 (configurable).
c. The iTM BACnet Server Gateway Option shall function as BACnet router to provide unique virtual BACnet device identification number (ID) for every indoor unit group address and every outdoor unit device.
d. The iTM BACnet Server Gateway Option shall provide configurable BACnet Network number.
e. The iTM BACnet Server Gateway Option shall be capable of being configured as a foreign device. It shall be capable of communicating across BACnet Broadcast Management Devices (BBMD) in different subnet networks.
f. The iTM BACnet Server Gateway Option shall be run in environments with BACnet communication traffic up to 100 packets/second.
g. The iTM BACnet Server Gateway Option functions shall be configurable through CSV file which shall be downloaded from iTM and configured by trained personnel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine products before installation. Reject products that are wet, moisture damaged, or mold damaged.

C. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION, GENERAL

A. Service Access:

1. Maintain manufacturer's recommended clearances for service and maintenance.
2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations.
3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
4. If less than full and unrestricted access is provided, locate components within an 18-inch reach of the finished assembly.

B. Equipment Restraint Installation: Install equipment with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Division 23.

3.3 INSTALLATION OF INDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch.

C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.

D. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

E. In rooms without ceilings, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.

F. Provide lateral bracing if needed to limit movement of suspended units.

G. Attachment: Install hardware for proper attachment to supported equipment.

3.4 INSTALLATION OF OUTDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Install outdoor units on support structures indicated on Drawings.

3.5 GENERAL REQUIREMENTS FOR PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved.

B. Where installing piping and tubing adjacent to equipment, allow space for service and maintenance.

C. Install piping and tubing in concealed locations unless otherwise indicated except in equipment rooms and service areas.

3.6 ELECTRICAL INSTALLATION

A. Comply with requirements indicated on Drawings and in applicable Division 26 Sections.

B. Comply with Division 26 for wiring, grounding, and bonding connections.

3.7 INSTALLATION OF SYSTEM CONTROL CABLE

A. Conform to Division 23 and 28 requirements.

3.8 IDENTIFICATION

A. Identify system equipment. Comply with requirements for identification specified in Division 23.

3.9 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to perform manufacturer’s recommended testing and to observe and inspect components, assemblies, and equipment installations, including controls and connections.

B. Products will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 STARTUP SERVICE

A. Engage a VRF HVAC system manufacturer's service representative to perform systems startup service.

1. Service representative shall be an employee or a factory-trained and -authorized service representative of VRF system manufacturer.
2. Complete startup service of each separate system.
3. Complete system startup service according to manufacturer's written instructions.

B. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service. Installer shall correct deficiencies found during startup service for reverification.

C. System Operation Report:

1. After completion of startup service, manufacturer shall issue a report for each separate system.
2. Report shall include documentation describing each startup check, the result, and any corrective action required.

3. Manufacturer shall electronically record not less than two hours of continuous operation of each system and submit with report for historical reference. All available system operating parameters shall be included in the information submitted.

3.11 ADJUSTING

A. Adjust equipment and components to function in accordance with manufacturer’s recommendations.

B. Lubricate equipment as recommended by manufacturer.

C. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.

D. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.

E. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.12 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of system Installer. Include four service visits for preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment and system operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.13 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software. Provide upgrade

notice at least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.14 DEMONSTRATION

A. Engage a VRF HVAC system manufacturer's employed training instructor or factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system. Perform not less than eight total hours of training.

B. Location: Owner shall provide a suitable on-site location to host classroom training.

C. Training Materials: Provide training materials in electronic format to each attendee.

1. Include instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
2. Video record each classroom training session and submit an electronic copy to Owner before requesting Owner acceptance of training.

D. Acceptance: Obtain written acceptance from Owner’s representative that training is complete, and requirements indicated have been satisfied.

END OF SECTION 23 81 29

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SECTION 23 82 36

FINNED-TUBE RADIATION HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes electric baseboard radiation heaters.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product.

    a. Include rated capacities, operating characteristics, furnished specialties, and accessories.

2. Shop Drawings:

    a. Include plans, elevations, sections, and details.
    b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    c. Include details and dimensions of custom-fabricated enclosures.
    d. Indicate location and size of each field connection.
    e. Indicate location and arrangement of integral controls.
    f. Include enclosure joints, corner pieces, access doors, and other accessories.
    g. Include diagrams for power, signal, and control wiring.
    h. Access door opening size in full open position and resulting space available behind the access door.

3. Color Samples for Initial Selection: For finned-tube radiation heaters with factory-applied color finishes.
4. Field quality-control reports.

B. Closeout Submittals:

1. Operation and Maintenance Data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 ELECTRIC BASEBOARD RADIATION HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Berko; Marley Engineered Products.
2. INDEECO.
3. Marley Engineered Products.
4. QMark; Marley Engineered Products.

B. Description: Factory-packaged units constructed according to UL 499, UL 1030, and UL 2021.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Heating Elements: Nickel-chromium-wire heating element enclosed in metallic sheath mechanically bonded to fins, with high-temperature cutout and sensor running the full length of the element. Element supports shall eliminate thermal expansion noise.

D. Unit Controls: Remote line-voltage thermostat.

E. Accessories:

1. Filler sections without a heating element matching the adjacent enclosure.
2. Straight-blade-type receptacles complying with DSCC W-C-596G/GEN, NEMA WD 1, NEMA WD 6, and UL 498; in color selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before installation of finned-tube radiation heaters.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BASEBOARD RADIATION HEATER INSTALLATION

A. Install units level and plumb.

B. Install enclosure continuously around corners, using outside and inside corner fittings.

C. Join sections with splice plates and filler pieces to provide continuous enclosure.

D. Install access doors for access to valves.

E. Install enclosure continuously from wall to wall.

F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 23 82 36

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SECTION 23 82 39.19

WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product.

    a. Include rated capacities, operating characteristics, furnished specialties, and accessories.

2. Shop Drawings:

    a. Include plans, elevations, sections, and details.
    b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    c. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
    d. Wiring Diagrams: Power, signal, and control wiring.

B. Closeout Submittals:

1. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Berko; Marley Engineered Products.
2. INDEECO.
3. Markel Products; TPI Corporation.
4. QMark; Marley Engineered Products.
5. Trane.

2.2 DESCRIPTION

A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.

B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

A. Fan: Aluminum propeller directly connected to motor.

B. Motor: Permanently lubricated. Comply with requirements in other Division 23 Sections.

2.6 CONTROLS

A. Controls: Through the Building Automation System.

B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall and ceiling unit heaters to comply with NFPA 90A.

B. Install wall and ceiling unit heaters level and plumb.

C. Ground equipment according to Division 26.

D. Connect wiring according to Division 26.

END OF SECTION 23 82 39.19

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SECTION 26 00 10

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes:
1. Descriptions
2. Quality Assurance
3. Record and Information Manuals
4. Examination of Site
5. Warranty
6. Definitions
7. Load Balancing
8. Scheduling
9. Coordination Between Trades
10. Coordination with Utility Companies
11. Owner Furnished Equipment
12. Materials and Equipment
13. Approved Equals
14. Manufacturer's Declaration
15. Installation
16. Painting and Related Work
17. Cutting, Patching, and Openings
18. Tests
19. Temporary Power
20. Cleaning

B. This Section applies to all sections of Division 26, 27, and 28.

C. All applicable requirements of other portions of the Contract Documents apply to the work of all sections of Division 26, 27, and 28, including, but not limited to, Division 01, General Requirements.

1.2 DESCRIPTIONS

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to complete and leave ready for operation all electrical systems as called for in these specifications or shown on the drawings and all details essential to complete the work. Items omitted from either the specifications or the drawings, but shown or described in the other trades, and all items necessary to make the electrical system complete and workable shall form a part of the work. No "extras" will be allowed.

B. By submitting a bid, the Contractor certifies that:
1. He is satisfied that he understands all site conditions that may have an effect on his bid price.
2. He fully understands the make-up, construction, and operation of all systems and equipment he is bidding on, and he has included in his price all materials, supplies, accessories, and services necessary to make these systems complete and operational.

C. Extent of Work: Work under this contract consists of furnishing, installing, testing, placing into operation, and guaranteeing complete electrical systems as shown on the drawings and as specified in Division 26, 27, & 28. The Contractor shall connect and place all wired equipment in proper working order. Refer to the plans and specifications for work included in this Contract. Some general guidelines to coordinating work between Division 26 and other Divisions are as follows:

1. Division 26 includes all power wiring and raceways for other Divisions' equipment. Division 26 is responsible to furnish and install motor starters and disconnect switches for Division 21, 22 and Division 23 equipment, unless otherwise noted. Remote two wire control logic will be extended to the motor starters as work of other Divisions. Where combined line voltage power/control is used for Division 21, 22 or Division 23 equipment, the wiring and raceways are treated as power wiring and are work of Division 26.
2. Division 26 is responsible for providing appropriate wire and conduit between all distribution equipment and all electrical devices and utilization equipment shown on plans. It is also the responsibility of Division 26 to provide all wire, conduit, and devices necessary to accomplish all control functions as indicated by the control diagrams which are not specifically shown as work of another division.

D. Abbreviations used in these specifications:
1. ADA - Americans with Disabilities Act
2. ANSI - American National Standards Institute
3. ASTM - ASTM International
4. CBM - Certified Ballast Manufacturers
5. EIA - Electronic Industries Association
6. ETL - Electrical Testing Laboratories
7. FCC - Federal Communications Commission
8. ICEA - Insulated Cable Engineers Association
9. IEC - International Electro Technical Commission
10. IES - Illuminating Engineering Society
11. IEEE - Institute of Electrical and Electronics Engineers
12. ITL - Independent Testing Laboratories
13. NEC - National Electrical Code
14. NECA - National Electrical Contractors Association
15. NEMA - National Electrical Manufacturer's Association
16. NESC - National Electrical Safety Code
17. UL - Underwriters Laboratories
18. A/E - Architect of Record or Engineer of Record

1.3 QUALITY ASSURANCE

A. Codes and Standards: Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
1. All work shall be installed in full accordance with the latest edition of the National Electrical Code (NEC) as prepared and published by the National Fire Protection Association (NFPA) and any applicable local or state codes. All electrical equipment shall be listed and labeled by Underwriters' Laboratories, Inc. (UL) or any approved independent nationally recognized electrical testing laboratory where such standards exist. Optionally, in lieu of such listing and labeling, equipment preapproved by the Electrical Inspector may be supplied. Wherever UL compliance is mentioned in the specifications, the above alternatives shall be understood to apply to all listing and labeling requirements. This does not preempt or replace the specifications or replace the approval process. All service switches/circuit breakers shall be listed and labeled as outlined above for service entrance duty.
2. Comply with the requirements of NFPA Code 241 "Building Construction and Demolition Operations," the American National Standards Institute (ANSI) A10 Series standards for "Safety Requirements for Construction and Demolition," and the National Electrical Contractors Association (NECA) National Joint Guideline NJG-6 "Temporary Job Utilities and Services."
3. In addition to the requirements outlined under other sections of the Contract Documents, all Work, material, and equipment shall comply with all requirements of the latest editions and interim amendments of the National Electrical Safety Code, National Fire Protection Association, OSHA, the building Owner's insurance company, and all applicable federal, state, and local laws and ordinances. All materials shall be listed and labeled by UL and installed as required by the listing.
4. Should any changes in the Drawings or the Project Manual be required to conform to the above regulations, the Contractor shall notify the A/E at the time of submitting his bid. After entering the Owner-Contractor Agreement, the Contractor shall be held to complete all Work necessary to meet these requirements without additional expense to the Owner.

B. Permits and Regulations
   1. The Contractor shall obtain all permits and inspections required by laws, ordinances, rules, regulations, and public authority having jurisdiction. The Contractor shall obtain certificates of such inspections and shall submit same to the A/E. The **A/E, Contractor** shall pay all fees, charges, and expenses in connection therewith. The Contractor shall furnish to the Owner a certificate of final inspection from the proper authority prior to final payment. Obtain and pay for easements required to bring temporary utilities to the site, where the Owner's easement cannot be utilized for that purpose.
   2. The Contractor shall not allow or cause any of the Work to be covered up or enclosed until the A/E or Owner has been notified and given reasonable opportunity (2 working days) to review the Work. When required by law or regulations, the governmental agency having jurisdiction for inspections shall be given reasonable notice and opportunity to inspect the Work. Any Work that is enclosed or covered up before such inspection and test shall be uncovered at the Contractor's expense; after it has been inspected, the Contractor shall restore the Work to its original condition at his own expense.

C. Interpretation of Drawings and Project Manual
   1. Any discrepancies between Drawings, Project Manual, Drawings and Project Manual, or within Drawings and Project Manual shall be promptly brought to the attention of the A/E for clarification during the bidding period. No allowance shall subsequently be made to the Contractor by reason of his failure to have brought said discrepancies to the attention of the A/E during the bidding period or of any error on the Contractor's part.
   2. The locations of switch, receptacle, light, motor, outlets, etc. shown on Drawings are approximate. The Contractor shall use good judgment in placing the preceding to eliminate all interference with ducts, piping, etc. Where any doubt exists, the exact location shall be determined by the A/E.
   3. Check all door swings so that light switches are not located behind doors. Relocate switches as required, with A/E's review.
   4. All general trades and mechanical Drawings shall be checked by the Contractor before installing any outlets, power wiring, etc.
   5. Equipment sizes and locations shown on the Drawings are estimated. Before installing any wire or conduit, the Contractor shall obtain the exact equipment requirements, including wire and conduit entrance locations, and install wire, conduit, disconnect switches, motor starters, overload heaters, circuit breakers, or other items of the correct size and locations for the equipment actually installed. However, wire and conduit sizes shown on the Drawings shall be taken as a minimum and shall not be reduced without written approval from the A/E.
   6. The Contractor shall provide all wiring, including disconnect switches and starters for all electrically operated equipment shown on Drawings, specified or required, except that starters and/or disconnect switches need not be furnished where it is specifically noted that they are furnished with the equipment.
   7. The Drawings show the general arrangement required for installation of equipment and materials. The Contractor shall follow these Drawings as closely as possible. Should conditions necessitate other arrangements, the Contractor shall prepare and submit drawings showing the changes to the A/E for review before proceeding with the Work.
   8. The A/E reserves the right to make minor changes in the location of the installation of equipment and materials up to the time of roughing in at no extra cost to the Owner.
   9. The Drawings do not show all offsets and do not detail every point at which unusual conditions of construction may require special attention. All additional fittings, conduits or specialties and other appurtenances necessary due to field conditions shall be provided by the Contractor.
   10. In all cases where a device or part of the equipment is herein referred to in the singular number, it is intended that such reference shall apply to as many such devices as are required to complete the installations.
   11. Wherever in Division 26, 27, & 28 a Manufacturer is specified with the notation "or approved equal" or "A/E approved", the decision as to the material or equipment being "equal" shall be made by the A/E without exception and this decision shall be accepted by the Contractor as final. Where the Contractor proposes to furnish equipment or material in accordance with the "or approved equal" notation said equipment or materials shall be submitted to the A/E, for review.
   12. Elevators: The location of switches, receptacles, lights, telephone outlets, etc., in elevator pits and shafts shall be located as required by the elevator Shop Drawings. Elevator controls shall be interlocked with fire alarm system for elevator recall function and fire fighter control.

1.4 RECORD AND INFORMATION MANUALS

A. Record drawings
   1. Prepare record documents in accordance with the requirements in Division 1 Section "Project Closeout." In addition to the requirements specified in Division 1, indicate installed conditions for:
      a. Raceway systems, size, contents, and location, for both exterior and interior; locations of all concealed utilities; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
      b. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
      c. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
      d. Any deviations made necessary to incorporate equipment different from the Design Base equipment.
      e. At completion of the project, contractor shall deliver record drawings to the A/E.
   2. The Record drawings must be kept current and accurate, and may be reviewed at any time by the A/E or Owner.

B. Operations and Maintenance Manuals
   1. Prepare maintenance manuals in accordance with Division 1 Section "Project Closeout." Compile and assemble the operation and maintenance data of equipment specified in Division 26 into a separate set of vinyl covered three ring binders, tabulated and indexed for easy reference. Data shall clearly indicate all options and accessories.
   2. The following items, together with any other necessary pertinent data, shall be included in each Manual:
      a. Each manual shall be labeled on front cover with project name, Contract, Contractor's name, A/E, and date of project completion.
      b. Manufacturers' names, nearest Factory Representative, and model and serial numbers of components of systems
      c. Operating instructions, start-up and shut-down procedures
      d. Maintenance instructions.
      e. Routine and 24-hour emergency service/repair information:
      f. Name, address and telephone number of servicing agency
      g. Names of personnel to be contacted for service arrangements
      h. Parts list with numbers of replaceable items, including sources of supply
      i. Manufacturers' literature describing each piece of equipment
      j. One approved copy of each submittal
      k. Written warranties
      l. Certificate of Material Receipt and Certificate of System Completion
      m. One typewritten directory for each panelboard as installed
      n. Record (as-built) drawings
      o. Certificate of Final Inspection signed by Building Authority having jurisdiction
      p. Test Results
      q. Coordination analysis (see "Power System Coordination Analysis")
      r. Video tapes of all equipment demonstrations and training sessions.
   3. In addition to the requirements listed above and specified in Division 1, include the following information for equipment items:
      a. Manufacturers' Descriptive Literature
      b. Final Signed Submittal Copy of Shop Drawings
      c. Spare Parts and Replacement Parts Lists
      d. Manufacturers' Maintenance and Service Manuals
      e. Project-Specific Description of Operation
      f. Wiring Diagrams
      g. Motor list including motor description, motor horsepower, motor voltage, fuse size, fuse type, and overload size.
      h. Fuse list including fuse location, fuse size, fuse type, and load description.
      i. Fixture Ballast Schedule
      j. Lamp Schedule
   4. Materials for more than one item shall clearly indicate which item or items are included on the Project.

5. Shop Drawings which are folded and punched for insertion in the Manual shall be such that the Drawings can be unfolded without removing them from the Manual, and all information shall be legible.

1.5 EXAMINATION OF SITE

A. Certain existing conditions may affect the manner or sequence of the performance of work. Review existing services and structures prior to bidding the work. Review operating schedules for existing systems and services. Coordinate the scheduling of the work with existing operations.

B. The contractor is encouraged to visit the site of the proposed project. After the contract is signed, no allowance will be made for lack of knowledge of the project conditions.

C. Verify and reconcile work required by the contract documents with conditions at the site prior to bid.

1.6 WARRANTY

A. Compile and assemble the warranties specified in Division 26 into a separate set of vinyl covered three ring binders, tabulated and indexed for easy reference.

B. Provide complete warranty information for each item. Information to include:
1. Product or equipment list.
2. Date of beginning of warranty or bond.
3. Duration of warranty or bond.
4. Names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.7 DEFINITIONS

A. Finished Areas: In general, areas with carpet or tile floors, lay-in or fixed ceiling tile, special architectural ceiling treatment, or tiled, plastered, or paneled walls shall be considered finished areas.

B. Interior: For the purposes of this specification, interior is any area within the boundaries of the foundation of any building within the superstructure or other structures not classified as a building.

C. Concealed: Embedded in or installed behind walls, within partitions, above suspended ceilings, below grade, in trenches, in tunnels and in crawl spaces.

D. Exposed: Not installed underground or "concealed" as defined above

E. Provide: To furnish and install (complete, tested, and ready for operation).

F. Furnish: To purchase and deliver products to the project site and make ready for installation.

G. Install: To take furnished products, assemble, erect, secure, connect, and place into operation.

H. Products: Includes materials, systems and equipment.

I. Work: The providing of products for entire contract.

1.8 LOAD BALANCING

A. It shall be the responsibility of the Contractor to balance the loads on the service system, all distribution systems, and all power equipment so that the variation in amperes per phase readings shall not exceed 5% under normal operating conditions.

B. Special care shall be taken during load balancing to prevent reverse rotation of motors.

C. If, during load balancing, a load is shifted from one phase to another in a color coded system, the Contractor shall paint or tape the ends of the wire at all outlet points with the proper color code for that phase. Failure to do so shall constitute justifiable grounds to require the Contractor to replace the entire circuit with the proper coded wire at no expense to the A/E or Owner.

1.9 SCHEDULING

A. General: It is mandatory that the facility be maintained in operation during construction and that periods of shutdown due to line changeovers, etc. are held to a minimum. These outages must be scheduled with and have the concurrence of the A/E and Owner. Further, it is mandatory that the completion of various stages of the electrical work coincide with the other phases of construction to maintain and permit operation of new installations as construction progresses.

1.10 COORDINATION BETWEEN TRADES

A. General
1. Coordinate all requirements of the Work of this Division with other Trade Contractors. Such requirements include, but are not limited to, locations, sizes, anchors, and similar items.
2. Provide all necessary information to other Trade Contractors for such coordination. Such information shall include conforming Shop Drawings, conforming Product Data, and all other required data.
3. This Contractor shall bear all costs for providing affected Work of related Trade Contractor(s) with no change to the Contract Sum or Date of Substantial Completion.
4. This Contractor shall coordinate all of his/her work with the General Trades Contractor for location of all devices, fixtures and equipment prior to rough-in.

B. Mechanical/Electrical Coordination
1. Plumbing, Fire Protection, HVAC, and Electrical Contractors shall coordinate their rough-in, service, and control requirements with each other. Electrical Contractor shall review all control drawings to coordinate exact number and locations of temperature control panels as well as to provide proper starters (including necessary time delays, auxiliary contacts, etc.).
2. All wiring required to power Plumbing, Fire Protection, or HVAC equipment shall be installed by the Electrical Contractor, including 120 volt to temperature control panels. All control and interlock wiring, regardless of voltage, is by the Contractor furnishing the control panel. The Division 28 Contractor shall be responsible for the wiring from the fire alarm control panel to the control device.
3. All electrical devices furnished as a part of Division 23 equipment, and installation requirements of all electrical work done by Division 23 Contractors shall conform to the applicable sections of Division 26.
4. Electrical Contractor shall coordinate with other Contractors prior to installation of switchboards and panelboards to insure requirements of NEC Articles 110 and 408 are met. The Contractor violating this requirement shall be responsible for the cost of all modifications required to comply to the satisfaction of the inspection agency for failure to meet the above code requirements.
5. If motors and/or equipment are furnished by other Divisions, which require larger starters, safety switches, circuit breakers, fuses, and/or branch circuit conductors than indicated, due to a larger size than specified, the Contractor furnishing the motors shall reimburse the Electrical Contractor for any cost differential.
6. Final operation of equipment provided under other Divisions shall be the responsibility of the other Divisions Contractor.
7. Motorized dampers on exhaust fans shall operate when exhaust fan is energized. Wire dampers to their respective motor leads to energize the damper motor and open the damper when the fan runs. Equipment, including dampers, operator, and transformer (if required) will be furnished by the fan

supplier. Motors fed from a variable frequency drive (VFD) shall be served from a separate branch circuit. Provide circuit to serve the dampers from the nearest panelboard (normal or emergency, to match motor). Control circuit through VFD damper control relay.

C. Foundations, Bases, Curbs, and Supports
1. Provide and coordinate all requirements for foundations, bases, curbs, and supports with the related Trade Contractor(s).
2. Provide required dimensions, templates, and all required information on anchors, sleeves, and cast-in-place accessories, including dimensions, to the related Trade Contractor(s).

D. Openings, Recesses, and Chases
1. Coordinate all requirements and locations for openings, recesses, and chases with the related Trade Contractor(s).

E. Final Connections
1. Coordinate with the related Trade Contractor(s) all requirements for rough-in and final connections for equipment installed under this Division.

1.11 COORDINATION WITH UTILITY COMPANIES

A. Description
1. The Division 26 contractor shall:
a. Coordinate division of responsibility with the utility companies serving the building.
b. Provide, furnish or install materials and labor not provided, furnished or installed by the utility companies.
c. Provide an allowance in the bid for utility aid-to-construction cost as follows:
i. Electric: $xxxxx.xx
ii. Telecom: $xxxxx.xx
iii. Cable: $xxxxx.xx

B. Division of work-electric power utility
1. In general, the power company will do the following:
a. Provide standard riser
b. Provide primary cable
c. Provide load break connectors
d. Provide Terminators
e. Provide grounding
f. Provide security padlock
g. Provide meter
h. Furnish meter trim
i. Furnish metering transformers
j. Provide meter wire from metering transformer to meter
k. Provide transformer primary
l. Provide terminal pole and framing

2. The electrical contractor is responsible for all other work, including the following:
a. Provide sleeve for grounding rod
b. Install meter trim
c. Provide conduit for meter wiring from transformer to meter trim
d. Provide guard post
e. Furnish easement or right-of-way
f. Provide concrete pad
g. Provide trenching
h. Provide primary duct
i. Provide secondary duct
j. Provide secondary conductors and lugs
k. Provide pulling wire, string, or rope, in duct

C. Division of work-Telephone utility
   1. In general, the telephone company is responsible for all service cable work, including furnishing and installing main service copper, fiber and coax cables to the building.
   2. The electrical contractor is responsible for all other work, including the following:
      a. Providing trenching and backfill for telecommunications service conduits.
      b. Furnishing and installing telecommunications service conduits.
      c. Provide a minimum of a #6 solid copper ground wire from main building ground to telecommunication plywood backboard location. Provide the service entrance plywood backboard and a 120volt GFCI with TVSS double duplex receptacle.

D. Division of work- – CATV and High Speed Data utility
   1. In general, the Cable TV & High Speed Data internet utility company is responsible for all service cable work, including furnishing and installing main service, fiber and coax cables to the building.
   2. The electrical contractor is responsible for all other work, including the following:
      a. Providing trenching and backfill for cable and internet communications service conduits.
      b. Furnishing and installing cable and internet service conduits.
      c. Provide a minimum of a #6 solid copper ground wire from main building ground to telecommunication plywood backboard location. Provide the service entrance plywood backboard and 120volt GFCI with TVSS double duplex receptacle.

1.12 OWNER FURNISHED EQUIPMENT

A. The Contractor shall make all necessary provisions for the Owner furnished equipment.

B. The Contractor shall remove, receive, store, uncrate, protect, and install the equipment in place, complete with field connections between shipping splits, feeder connections, and all appurtenances required to place the equipment in operation, ready for use. The Contractor shall be responsible for the equipment when received, as if he had purchased the equipment himself.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. New material and equipment; all bearing manufacturer's name, model number, or other identification marking.

B. Provide standard product; latest design with published properties of manufacturer regularly engaged in production of specified material or equipment for minimum 5 years (unless exempted by A/E).

C. Unless otherwise scheduled or indicated, equipment of same type in same room must match as to color, finish, and design.

D. Unless otherwise submitted to and approved by A/E, equipment and its devices must be of same manufacturer; or devices must be approved and warranted by equipment manufacturer.

E. Whenever the Contractor furnishes equipment or material other than the Design Base Manufacturer specified, the Contractor is responsible for the cost and coordination of all modifications required not only for his work, but also for the work of all other Trades affected. Where changes to other Trades' work are required, this Contractor must include the additional costs of all such work in his bid and ultimately make arrangements with these other Trades for such changes and compensate them accordingly. Where changes to design are required, the Contractor shall submit such changes to the A/E for approval. The Contractor shall investigate potential conflicts such as the following:
   1. Provide Physical dimensions and weights
   2. Code required working clearances
   3. Connecting pipe sizes

4. Additional control and interlock wiring
5. Lug size and quantity
6. Increased wire size, fuse size, and motor control equipment size
7. Increased ventilation requirements
8. Battery capacity
9. Sound levels of audible devices
10. Increased withstand and interrupting ratings of downstream equipment due to differences in over-current protective device characteristics

2.2 APPROVED EQUALS

A. Equal (equivalent) components (articles, devices, materials, forms of construction, fixtures, etc.) by manufacturers not listed but meeting the specifications may be submitted to the A/E for approval and subsequent inclusion into the bidding documents. Submission must be received no later than 10 working days before bid date. If approved, such manufacturers will be listed in an addendum.

B. Submittals must include all of the following:
   1. Cover Letter: Company letterhead; addressed to A/E. Indicate the following
      a. Project name, project number, and phase or bid package if applicable
      b. Specification Section by number and title
      c. Specified Product
      d. Proposed Product
      e. Deviations, if any, from Specified Product
      f. List of attachments
   2. Product Data: Manufacturer's literature, fully describing proposed product with exact item highlighted or clearly indicated.
   3. Specifications: Manufacturer's specifications with all modifications noted as required to show compliance with Bidding Documents.
   4. Test Data: Where performance requirements are specified, submit laboratory tests to indicate compliance.
   5. Samples: Submit appropriate samples of proposed product when required by A/E, showing color, texture, construction and other attributes necessary for evaluation.

2.3 MANUFACTURER'S DECLARATION

A. Submit a list of the suppliers of Major Equipment to be used on this project. This shall be submitted with the bid. This list shall be typed on company letterhead and shall list the project title. The manufacturer and catalog number/type shall be listed adjacent to each specification section number and product description.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Rough-In
   1. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
   2. Refer to equipment specifications in other Divisions for rough-in requirements.

B. Electrical Installations
   1. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
      a. Coordinate electrical systems, equipment, and materials installation with other building components.
      b. Verify all dimensions by field measurements.

c. Coordinate and provide chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
d. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete or supported from or on other structural components, as they are constructed.
e. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building and equipment which must be placed in service before further construction can take place.
f. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
g. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service and place each in proper operating order.
h. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that the work is shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the A/E before final placement.
i. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
j. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
k. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.2 PAINTING AND RELATED WORK

A. Finish painting in areas of new construction is the responsibility of the General Trades Contractor and is specified in Division 9.

B. Any other painting, required by Sections in Division 26, is the responsibility of the respective Division 26 Contractor. It shall meet the requirements of Division 9. Each Contractor is responsible for repainting of finished areas disturbed by his own cutting and patching.

C. Factory-finished equipment which has rusted or has been damaged shall be cleaned, spot primed with zinc chromate, and finished to the original quality and color by the Contractor.

D. Support steel shall be cleaned, rust removed, primed, and painted.

3.3 CUTTING, PATCHING AND OPENINGS

A. Unless otherwise required in General or Special Conditions, Contractor shall perform all cutting and patching required for his own work. Work must be accomplished in a neat and workmanlike manner, acceptable to the A/E.

B. If necessary to cut into work of other Trades, it shall be done by other Trades at this Contractor’s expense. Patching shall be similarly executed.

C. Cutting, burning or drilling of structural support beams, joists, plates, or other structural members is strictly prohibited without the specific written consent of the A/E. Use rotary drills where cutting holes through concrete, brick, plaster, or tile is necessary. Obtain approval of the A/E before proceeding with work.

D. The General Trades Contractor shall locate and size openings for conduit, bus-way or other items prior to construction.

E. All cutting and patching shall be done promptly and all repairs shall be made as necessary to leave the entire work in good condition, including all cutting, fitting, and drilling of masonry, concrete, metal, wood, plaster, and other materials as specified or required for proper assembly, fabrication, installation, and completion of all work of the Contract.

F. Patching shall match adjacent materials and shall be accomplished only by trades men skilled in the respective craft required. Materials and equipment used in the patching work shall comply with requirements of those Sections of the Specification relating to material to be used in new construction.

G. Electrical provides:
1. All opening and hole information through floors, walls, and roofs for his work; Including all pipe and conduit, inserts, hangers, and plates.
2. Exact information to other contractors as to size, depth, and location of such openings before construction is in place; and delivery and setting in place of all boxes, sleeves, inserts, and forms for his work in time for installation in all locations.
3. All cutting, patching and restoration to accommodate Electrical contractor's failure to provide specified date in time for openings to be left or to accommodate boxes, sleeves, inserts, and forms after construction has been Completed by other contractors.
4. Skilled craftsmen to cut, patch, rebuild, restore, replace, refinish and repaint new construction cut, disturbed, or marred by him to original or new condition; for installation of new, exposed, concealed, underground, or underfloor work of all kinds; for admission of new work and equipment; for installation of new equipment and new work in new construction; for complete restoration of pipe, duct, or equipment covering disturbed or marred by his personnel.

3.4 TESTS

A. The Contract Documents, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction may require portions of the work to be inspected, tested, or approved. These services shall be performed by approved agencies.

B. The A/E must be notified of all scheduled tests and adjustments at least 48 hours before they are scheduled so that he may witness same. If the Contractor performs any test or adjustment without the A/E present, or without proper notification, the Contractor may be required to perform the test or adjustment a second time. All schedules are to be coordinated with the A/E and Owner far enough in advance so-as to minimize inconvenience.

C. Tests shall include: **[Edit for project]**
1. Proper operation of lights and equipment.
2. Continuity of conduit system.
3. Insulation leakage and impedances.
4. Ground system resistance.
5. Any sub-system tests described in other Sections of these Specifications.
6. Record line voltage at service entrance equipment with all systems operating.

D. Provide a signed statement that all tests have been performed and have met all requirements as described in other Sections. This signed statement shall be incorporated into the Record and Information Manual.

E. The Contractor shall bear all costs of such inspections, tests, or approvals.

3.5 TEMPORARY POWER

A. Provide temporary electrical power to be used for construction purposes by all contractors in accordance with Division 1. Provide all fixtures, wiring, and equipment, and make all connections required for temporary electrical service during the construction period; coordinate all power and lighting requirements with the various trades. Contractor to pay for energy consumption, and any utility company charges to establish service.

1. Temporary Service Panels: Provide a minimum of one 100 ampere rated service panel in a location or locations within 200 feet of all building work areas; include as many such panels as required to meet 200 foot maximum distance. Provide all wiring and raceways required for service connection and branch circuit wiring connecting each panel to the serving utility and to the following electrical loads; obtain all permits required.
2. Lighting: Provide minimum of 5 foot-candles of illumination in all building work areas where construction work is being accomplished; increase illumination to 50 foot-candles for painting, plastering and other interior fine finish work.
3. Outlets: Provide duplex receptacle outlets on 100 foot centers maximum; arrange and locate so that no work area of the building is more than 100 feet from a 120-volt outlet; allow no more than 5 outlets on any 20-ampere circuit.
4. Power Circuit Breaker: Provide one 100-ampere, 208-volt, 3-phase or 240-volt, 1-phase circuit breaker in each panel for power equipment.

B. Power shall be obtained from the local electrical utility.

C. Temporary power shall not be obtained from the generator purchased as part of this project.

3.6 CLEANING

A. Upon completion of work, all materials and equipment furnished in this contract shall be thoroughly cleaned of dirt, grease, rust, and oil. Prepare for finish painting, where painting is specified.

END OF SECTION 26 00 10

SECTION 26 00 15

SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes administrative and procedural requirements for submitting shop drawings, product data, color samples, and other miscellaneous submittals.

B. This section applies to all sections of Division 26, 27 and 28.

1.2 DEFINITIONS

A. Action Submittals: Written information that requires the Engineer's responsive action. Materials and equipment submitted shall meet all the requirements of the Contract Documents. No materials or equipment shall be ordered until the submittal has been reviewed and processed as "Reviewed for Compliance" or "Conform as Noted" by the Contractor, Architect, and Engineer.

B. Informational Submittals: Written information that does not require the A/E's review. Information is submitted for record purposes only and will not be reviewed by the A/E. It is the Contractor's responsibility to make sure materials and equipment comply with the Contract Documents prior to ordering. If reviewed however, the submittals may be rejected for non-compliance with the requirements of the Contract Documents.

C. Reviewed for Compliance: The submittal was reviewed for compliance by the Engineer and the submittal was found to generally conform with the design concept and Contract Documents.

D. Conform as Noted: The submittal was reviewed for compliance by the Engineer and the submittal was found to generally conform with the design concept and Contract Documents with the exception of the items noted. The items noted by the Engineer must be changed and/or included, however, the submittal should not be resubmitted.

E. Revise and Resubmit: The submittal was reviewed for compliance by the Engineer and the submittal did not conform with the design concept and Contract Documents. The items noted by the Engineer must be changed or included and the submittal must be resubmitted.

F. Does Not Conform: The submittal was not reviewed because it is incomplete, inadequate for review, or does not meet the submittal requirements listed in the 'Quality Assurance' section below. The Contractor shall review the submittal requirements and resubmit.

1.3 QUALITY ASSURANCE

A. The review of shop drawings by the A/E does not relieve the Contractor from his/her responsibility to comply with the project documents nor does it authorize any additional cost. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities, dimensions and weights, for selecting fabrication processes, for techniques of assembly, for performing his/her work in a safe manner and for all coordination of the work with all trades.

B. Contractor assumes complete responsibility for changes required and contract delays, including that of other trades, as a result of his/her chosen materials and equipment.

C. All submittals shall bear the Contractor's certification that he/she has reviewed, checked, and approved the submittal, that they have been coordinated with the requirements of the project and the provisions of the Contract Documents, and ~~the~~ that he/she has verified all field measurements and construction criteria, materials, catalog numbers, and similar data. Submittals without a Contractor's approval will not be reviewed, will not be returned, and the Contractor will be notified.

D. Submittals shall identify the manufacturer, specific model number, performance data, electrical characteristics, overall size, features, specified options, wiring diagrams, and any other information necessary to determine if the product or equipment conforms with the contract documents. Contractor shall submit only material applicable for the project, where catalog pages are submitted the contractor shall identify the specific items that apply. Additional equipment specific requirements may be listed in other spec sections.

E. Submittals shall include the complete package of equipment materials, piping, and insulation pertaining to that piece of equipment. A package of equipment requiring long lead times should be submitted as early as possible.

F. Where other specification sections require field quality control reports to be prepared by a Qualified Testing Agency, submit testing agency qualification as part of the Informational Submittals. Testing Agency shall be a member company of NETA or an NRTL.

G. All submittals must be issued individually by specification section.

H. Submittals which do not conform with the requirements above **WILL NOT BE REVIEWED**; they will be returned to the Contractor marked "Does Not Conform".

1.4 SHOP DRAWING SUBMITTAL PROCEDURES

A. Electronic copies of the Contract Documents are available from the A/E for Contractor's use in preparing submittals.

B. Contractor shall submit electronic copies of all shop drawings in PDF format. Electronic submittals shall be emailed to submittals@aecmep.com and the AEC Project Manager. Other means of file transmission such as FTP or other file format types shall be mutually agreed upon.

C. Contractor shall prepare a title page for each submittal containing the following information:
1. Indicate name of firm and individual with contact information for entity that prepared each submittal.
2. Project name as listed on contract.
3. Specification section number and title.
4. Material or Equipment specified.
5. Date.

PART 2 - PRODUCTS

2.1 SHOP DRAWING SUBMITTALS REQUIRED

A. Submit information for all equipment described in the specifications and on the drawings.

2.2 INFORMATION SUBMITTALS

A. Equipment specific information submittals are listed within equipment specification sections. General information submittal requirements are listed below. Information submittals shall be provided when indicated within equipment specifications sections.

1. Qualification Data: For qualified testing agency
2. Seismic Qualification Data: Certificates, for equipment, accessories, and components, from manufacturer.
3. Source quality-control reports.
4. Field quality-control reports.

2.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Provide all information in bound 3-ring binder as well as digital format. Include the following information:

1. All approved shop drawings.
2. All information submittal information.
3. Contractor's warranty and any specific equipment warranty provided by equipment manufacturers.
4. Inspection certificates.
5. Routine maintenance requirements and maintenance intervals for installed components as well as the name and address of qualified service agencies for all major equipment.
6. Manufacturer's written instructions for testing and adjusting equipment.
7. Spare parts list.

B. Project close-out material: Provide as described in Division 01.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Notify the A/E in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents. The Contractor must boldly note all deviations on the submittal.

B. Make submittals promptly in accordance with the approved schedule and in such sequence as to cause no delay in the work of the Contractor or any other Contractor.

C. Correct or change and then resubmit rejected submittals as required until approved. The Contractor must clearly note all revisions on resubmitted submittals. Resubmittals without the revisions noted may be returned without review.

D. Do not begin fabrication or work that requires an Action Submittal until submittal is processed as "Reviewed for Compliance" or "Conform as Noted" by the A/E.

END OF SECTION 26 00 15

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SECTION 26 00 20

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes:
   1. Sleeves
   2. Seals
      a. Watertight Seals
      b. Fire Rated Seals
      c. Oil Resistant Service Seals
      d. Corrosive Service Seals
      e. Explosion Proof Seals
   3. Firestops
   4. Concrete
   5. Access Panels
   6. Coordination Drawings

B. This Section applies to all sections of Division 26, 27, and 28.

1.2 SUBMITTAL

A. Action Submittals:
   1. Manufacturer's product data sheets indicating product characteristics, performance and limiting criteria
   2. Manufacturer's installation instruction for each type of seal or firestop required by the project
   3. Written certification that firestopping systems meet firestopping requirements specified herein
   4. Concrete compression testing reports

1.3 QUALITY ASSURANCE

A. Codes and Standards: Perform all work associated with basic electrical materials in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein. Where provisions of the pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
   1. American Institute of Steel Construction (AISC) "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings."
   2. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel."
   3. National Electrical Code (NEC).

1.4 COORDINATION

A. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. Field verify and coordinate with the General Trades Contractor all locations and dimensions to ensure that the equipment will be properly located, readily accessible, grouped with other trades equipment as

needed, and installed in accordance with all pertinent codes and regulations, the contract documents, and the referenced standards.

C. The work shall be carefully laid out in advance, and where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary for the proper installation, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.

D. In the event any discrepancies are discovered, immediately notify the A/E in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Seals
      a. Link-Seal by Thunderline Corporation
      b. CSD Sealing Systems
      c. O-Z/Gedney Inc.
      d. Crouse Hinds
      e. Appleton
   2. Firestopping Materials
      a. Hilti
      b. Tremco Sealants & Coatings
      c. 3M Fire Protection Products
      d. Dow Corning
      e. CSD Sealing Systems
      f. Insta-Foam Products, Inc.
      g. The Carborundum Co.
   3. Access Panels
      a. Milcor
      b. Zurn
      c. Larsen’s
      d. Acudor
      e. JL
      f. Nystrom
      g. Karp

2.2 SLEEVES

A. Sleeve material through floors and walls shall be machine cut rigid galvanized steel conduit.

B. Sleeves installed in new construction shall have welded flange at mid-point of sleeve which functions as a water barrier and anchor collar.

C. At the contractor’s option, steel wall sleeves by Link-Seal may be provided.

2.3 SEALS

A. Modular mechanical type
   1. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between conduit and sleeve.

2. Seal assembly shall have steel bolts and nuts and rubber sealing element for service and environment under which assembly will be used. Seal shall have a pressure resistance rating of 20 psig.

B. Sealing plug type
1. Seals shall consist of two identical piece plugs made of synthetic rubber with one edge flanged, serrated profile on the outside and a series of ridges on the inside which compress and assures a tight seal. Seal shall have a pressure resistance of 15 psig at the plug base and 30 psig at the flange. Rubber grade shall be suitable for the service and environment under which sealing plug will be used.

2.4 WATERTIGHT SEALS

A. Modular mechanical type watertight seals shall have zinc galvanized bolts and nuts with EPDM rubber sealing element. Seals shall be Link-Seal, Type C.

B. Sealing plug type watertight seals shall be made of EPDM rubber. Seals shall be by CSD Sealing Systems.

2.5 FIRE RATED SEALS

A. Modular mechanical type fire seal shall have zinc galvanized bolts and nuts with silicone rubber sealing element which provides a three hour fire resistance rating. Seals shall be Link-Seal, Pyro-Pac, model FS.

B. Sealing plug type fire rated seals shall be made of FRR rubber for three hour fire resistance rating, Seals shall be by CSD Sealing Systems.

2.6 OIL RESISTANT SERVICE SEALS

A. Modular mechanical type oil resistant service seals have stainless steel bolts and nuts with Nitrile rubber sealing element. Seals shall be Link-Seal, Type O.

B. Sealing plug type oil resistant seals shall be made of Nitrile rubber. Seals shall be by CSD Sealing Systems.

2.7 CORROSIVE SERVICE SEALS

A. Modular mechanical type corrosive service seals have stainless steel bolts and nuts with rubber sealing element having high resistance to most organic compounds, acids, alkalis and related chemicals. Seals shall be Link-Seal, Type S.

B. Sealing plug type corrosive service seals shall be made by Viton rubber. Seals shall be by CSD Sealing Systems.

2.8 EXPLOSION PROOF SEALS

A. Seals shall resist the passage of gasses, vapors, or flames and be UL approved for the application. Materials shall include iron alloy and/or ductile iron. Fill material shall be applied in place, after installation. The following features shall be included:
1. Stainless Steel drain fittings shall be installed in vertical conduit runs to prevent the accumulation of condensate above the seal.
2. Taper tapped hubs to assure grounding continuity.

2.9 FIRESTOPS

A. General
1. Use only firestop products that have been UL 1479, ASTM E-814 tested for specific fire rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
2. Cast-in-place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic pipe (closed and open piping systems), or electrical cable bundles, penetrating concrete floors.
3. Sealants, foams or caulking materials for use with non-combustible items including rigid steel conduit and electrical metallic tubing (EMT).
4. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including PVC jacketed, flexible cable or cable bundles and plastic pipe.
5. Foams, intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles.
6. Non-curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles.
7. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes.
8. Materials used for complex penetrations shall be made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
9. Non-curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
10. Firestopping materials shall conform to both Flame (F) and Temperature (T) Ratings as tested by nationally accepted test agencies per ASTM E-814 or UL1479 Fire Tests of Through-Penetration Firestops.
    a. The F rating shall be a minimum of one (1) hour, but not less than the fire resistance rating of the assembly being penetrated.
    b. Conduct the fire test with a minimum positive pressure differential of 0.01 inches of water column.

2.10 CONCRETE

A. All concrete work incidentals to the work of Divisions 26, 27, and 28 is the responsibility of the Division 26 contractor. Such concrete includes, but is not limited to:
1. Encasement of underground raceways where specified in the section "Underground Ducts and Raceways"
2. Lighting fixture foundations
3. Service transformer pad
4. Primary switch concrete pads unless noted otherwise on the Drawings. Coordinate exact pad requirements and location with the Electric Utility Company if they provide the transformer.
5. Concrete collars around conduit and busway
6. Emergency generator concrete equipment base
7. Housekeeping pads

2.11 ACCESS PANELS

A. Furnish ceiling and wall access panels as necessary for access to pull boxes, junction boxes, remote ballasts, electrical equipment, etc., requiring service, adjustment or maintenance.

B. Access panels are to be turned over to the General Trades Contractor for installation.

C. Ceiling Access Panels
1. Drywall Ceilings: 24” x 24”, Milcor Style DW, 16 gauge steel frame with 14 gauge door panel, double acting concealed spring hinges, cylinder lock, prime painted for finish painting with ceiling.

2. Fire-Rated Ceiling: 24” x 24”, Milcor fire-rated access door, UL approved, 16 gauge steel frame with 18 gauge recessed door panel, 20 gauge panel sides and 26 gauge panel hat channel, continuous hinge, self-latching cylinder lock, prime painted for finish painting.
3. Plaster Ceilings: 24” x 24”, Milcor Style AP with finish material same as ceiling material or Style K, 16 gauge galvanized steel frame with 18 gauge galvanized steel door panel. 24" x 24" and larger panels shall be reinforced, continuous hinge, cylinder lock, prime painting for finish painting to match ceiling.
4. Acoustical Concealed Spline Ceilings: 24” x 24”, Milcor Style AT, 16 gauge steel frame with an 18-gauge steel recessed door panel. 24" x 24" and larger panels shall be reinforced, continuous hinge, cylinder lock, prime painted for finish painting.

D. Wall Access Panels
1. Drywall: 24” x 24”, Milcor Style DW, 16 gauge steel frame with 14-gauge door panel, double acting concealed spring hinges, cylinder lock, prime painted for finish painting with wall.
2. Masonry and Tile: 24” x 24”, Milcor Style M Standard, 14 gauge steel frame and door panel, concealed spring hinges, cylinder lock, prime painted for finish painting with wall or Style M stainless.
3. Fire-Rated: 24” x 24”, Milcor fire-rated access door, UL approved, 1-1/2 hour, Class B rating, 16 gauge steel frame, 20 gauge insulated door panel continuous hinge, automatic door closer, cylinder lock, interior release mechanism, prime painted for finish painting with wall.
4. Plaster: 24” x 24”, Milcor Style K, 16 gauge steel frame with 14 gauge door panel and 22 gauge galvanized casing beads, concealed spring hinges, cylinder lock, prime painted for finish painting with wall.

2.12 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access panels.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures, duct work, piping, and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. All penetrations through Fire-rated enclosures.

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger. Include proposed elevation of conduits and raceways.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations. Include elevation of fixtures and devices.
    c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines. Include mounting elevations.

8. Fire-Protection System: Show the following:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
    b. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    c. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    d. All penetrations through Fire-rated enclosures.

9. Review: Engineer will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make changes as directed and resubmit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Sleeves
1. Furnish and install sleeves for all penetrations through masonry and concrete construction, smoke or fire rated separations, and equipment room walls and floors.
2. Carefully coordinate and check locations of sleeves immediately before and after each concrete pour and masonry installation.
3. Give the General Trades Contractor locations and sizes of all openings required for the installation of sleeves before construction of masonry or concrete walls is started. If it becomes necessary to cut into new work because of the failure of this Contractor to notify the General Trades Contractor,

then the General Trades Contractor shall do any necessary cutting and patching required at this Contractor's expense.

4. Cut sleeves through walls flush with each surface. Unused sleeves shall extend beyond wall surface, filled with and surrounded by fire barrier materials, and be provided with caps.
5. Cut sleeves 2 inches above finished floors and 3 inches above floors in equipment rooms and shafts. Bottom of sleeve to be cut flush.
6. Core drill holes for sleeves in existing construction.
7. Patching shall be by the General Trades Contractor at this Contractor's expense.
8. Sleeves must be installed plumb with respect to wall.
9. Pack the space between sleeves and conduits or cables with approved fire barrier sealant to maintain fire rating of structure. Fill space around all sleeves leading into exposed areas with material compatible with adjacent construction and finish or fire barrier sealant material to maintain fire rating of the structure.

B. Seals and Firestops
1. Clean surfaces and substrates of dirt, oil, loose materials and other foreign materials which may affect the proper bond or installation of seals and firestops.
2. Do not apply seals and firestops to surfaces previously painted or treated with a sealer curing compound or similar product. Remove coatings as required in compliance with manufacturer's instructions. Provide primers, as required, which conform to manufacturer's recommendations for various substrates and conditions.
3. Follow manufacturer's written instructions for installation of seals and firestops.
4. Install firestops with sufficient pressure to fill seal holes, voids and openings to ensure an effective smoke seal and to maintain the fire resistance rating of the assembly.
5. Tool or trowel exposed surfaces. Remove excess firestop material promptly as work progresses and upon completion.
6. Unused sleeves shall be filled with and surrounded by firestop material. Sleeve ends shall be capped. Blind sealing plugs may be used at Contractor's option.
7. Install watertight seals for all below grade penetrations of conduit into the building.
8. Install fire rated seals in all fire rated walls and floors.
9. Install oil resistant service seals in environment where oils, fuels, solvents and other petroleum - base products are used.
10. Install corrosive service seals in environments where organic materials, acids, alkalis and related chemicals are used.

C. Concrete
1. Provide concrete compression testing for light pole foundations and exterior equipment pads.
2. Do not mount equipment on concrete supports until concrete has had sufficient setting time (seven days minimum).

D. Access Panels
1. Coordinate locations and installation of panels required to permit convenient access to electrical equipment requiring adjustment, service or maintenance. Mark locations of access panels on Record Drawings

3.2 FIELD QUALITY CONTROL

A. Examine seals and firestops to ensure proper installation and full compliance with this specification. Work shall be accessible until inspection and approval by the applicable code authorities.

B. Correct unacceptable seals and firestops and provide additional inspection to verify compliance with this specification at no additional cost to the owner.

END OF SECTION 26 00 20

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SECTION 26 00 25

ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Work of this Section includes, but is not limited to:
   1. The removal of all items of existing construction not to remain as a part of the final Project.
      a. Remove all existing electrical equipment, wiring, and conduit in the areas to be remodeled, in this Project, unless noted otherwise.
      b. Existing equipment serving other areas, but interfering with the construction, shall be relocated as directed by the A/E or Owner.
   2. Any demolition indicated on the Drawings is shown in general to indicate the extent of demolition and is not to be considered as a record drawing of existing conditions. Accordingly, the Contractor shall be responsible for complete demolition of the electrical work indicated including any buried items or any existing items not shown on the Drawings. Before demolition and before submission of proposed methods and operations, the Contractor shall be responsible to obtain for reference any existing record drawings to determine the nature of the existing electrical work to be demolished.
   3. Protect existing Work remaining in place.
   4. Protect the public.
   5. Repair and restore to original condition all items or portions of electrical work which are not noted to be demolished but are damaged by Work under this Contract.
   6. In existing areas not otherwise being remodeled but requiring new mechanical or electrical services or new services passing through, coordinate for cutting, patching, removal and replacement of ceilings, walls, floors and/or slabs with the trade requiring access.
   7. Coordinate electrical demolition with all other trades.

B. Sustainability Compliance
   1. Refer to Section 26 00 10, Electrical General Requirements, for sustainability compliance requirements for this project that impact products furnished under this specification section.

C. Seismic Compliance
   1. Refer to Section 26 00 10, Electrical General Requirements, for seismic compliance requirements for this project that impact products furnished under this specification section.

1.2 EQUALITY ASSURANCE

A. Delegated Design: Design Professional Qualifications and Quality Control Procedures
   1. Design QAQC Plan
   2. Design Professional Qualifications
      a. Quality Control Reviewers Qualifications/Certifications

1.3 FIELD CONDITIONS

A. General
   1. The Owner assumes no responsibility for the actual condition of structures and electrical work to be demolished.
   2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner in so far as practicable. However, variations within the structure may occur by Owner's removal and salvage operations prior to the start of the Demolition Work.

3. Items of salvable value to the Contractor may be removed as the Work progresses. Salvages items must be transported from the Site as they are removed. Storage or sale of removed items on the Site will not be permitted.

B. Explosives
1. The use of explosives will not be permitted.

C. Protection
1. Conduct demolition and removal of debris to ensure minimum interference with roads, streets, walks, and other facilities.
2. Do not close or obstruct streets, walks or other facilities without permission from the governing authority. Provide alternate routes around obstructed traffic ways as required by governing regulations.
3. Ensure safe passage of persons around the area of demolition. Conduct operations to prevent injury to adjacent property and persons.
4. Promptly repair damage caused to adjacent facilities at no cost to the Owner.

D. Utilities
1. Shut-off active utilities
   a. Where existing electrical service is to be permanently abandoned, shut-off and cap or arrange with proper utility company for shut-off.
   b. Where existing electrical services are to be rerouted, or reused in new Work, shut-off, cut and install temporary switches to minimize future shut down periods.
2. Existing utilities to remain: Maintain in service and protect against damage.
3. Existing electrical services to be rerouted: Where electrical services remaining in service interfere with demolition or future construction, shut-off, disconnect, remove, relocate and reconnect as shown or required.
4. Shut-down periods:
   a. Arrange timing of shut-down periods of all in-service utilities with the Owner. Do not shut-down any utility without prior written approval.
   b. Keep shut-down period to a minimum or use intermittent period as directed. Shut-down periods may require premium time Contractor work.

PART 2 - PRODUCTS

2.1 SALVABLE ITEMS REMOVED BY OWNER

A. All items of furnishings and equipment not attached to the building or to utilities will be removed by the Owner prior to start of Demolition Work. Coordinate with Owner's representative all items to be salvaged and store on site as directed.

2.2 SALVABLE ITEMS REMOVED BY CONTRACTOR

A. All lighting fixtures, lamps and materials or equipment of significant value removed shall be turned over to the Owner. All other materials, such as conduit, boxes, wire, etc., shall become the property of the Contractor and shall be removed from the Project Site

2.3 NON-SALVABLE MATERIAL AND FILL

A. All other materials, equipment, fixtures, and debris become the property of the Contractor and shall be removed from the Site.

PART 3 - EXECUTION

3.1 SCHEDULE

A. Coordinate and sequence demolition so as not to cause shutdown of Owner operation.
   1. Do not proceed with demolition without written authority to proceed signed by the Owner.

B. Proceed with demolition in a systematic manner and coordinate with all trades involved.

3.2 PROTECTION

A. Use water sprinkling, temporary enclosures, and other approved methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.
   1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, pollution and electrical shock.
   2. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations, as directed. Return adjacent areas to condition existing prior to the start of the Work.

B. Do not throw materials from windows or use metal chutes. Use hoists, wheelbarrows, plywood chutes or other acceptable methods.

C. In removal of existing materials, take care not to damage Work remaining in place, salvable materials, or equipment. Repair or replace any existing construction, materials, or equipment damaged during demolition, to the Owner's satisfaction at no additional cost.

D. Remove all materials completely and neatly, leaving surfaces smooth and ready for new Work. Sawcut where necessary. Do not use jackhammers as a means of cutting.

3.3 DEMOLITION

A. Locate demolition equipment so as not to impose excessive loads to supporting walls, floors, roof or framing.

B. Carefully remove equipment and materials, or fixtures which are to be reused.

C. Remove all combustible materials from the Site.

D. Disconnect or shut off service to areas where electrical work is to be removed. Remove all electrical fixtures, equipment and related switches, outlets, conduit and wiring which are not a part of the final Project in all areas where Work of this Contract is to be performed.

E. Maintain all existing circuits to items that are to remain in use.

F. Existing outlets which are to be removed and have conduits rising from the floor slab shall have the conduits cut below floor level. Rework as required to provide feed-through service to other remaining outlets. Pull new wire between remaining outlets affected by feed-through. Patch floor as required to restore to original condition.

G. All conduits not embedded in concrete shall be removed. Conduits protruding from concrete shall be cut below floor level. Patch floor as required to restore to original condition.

H. Abandoned outlet boxes in walls to remain shall be closed with blank coverplates. If equipped with devices, the devices shall be removed and the conductors removed to the adjacent outlet or reconnected as required to provide feed-through service.

I. Panelboards flush in masonry walls shall have their bussing removed and a blank steel plate installed over the panelboard cabinet to cover the entire opening.

J. Disconnect and remove electrical connections to equipment designated to be removed by other trades.

3.4 RELOCATION

A. Items designated to be relocated, shall be removed and stored until the construction is ready for their installation.

B. All lighting fixtures designated to be relocated shall be cleaned and relamped.

3.5 EXISTING EQUIPMENT TO REMAIN

A. All electrical items and lighting fixtures designated to remain are to be cleaned, in addition, lighting fixtures shall be relamped. All outlet boxes shall have knockout plugs installed in unused openings. All panelboards are to have blank covers installed in unused circuit breaker spaces.

B. All existing outlets, equipment, and associated wiring and conduit systems which interfere with the work of the General Trades, Structural, Plumbing, Fire Protection, or HVAC Contractors shall be reworked as required to maintain system operation. Relocate conduits where they will not interfere with new work of other trades.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Disposal of hazardous materials (ex: lighting fixture ballasts) shall be in accordance with Federal and State Environmental Protection Agency regulations. A signed statement signifying proper disposal shall be furnished to the Building Owner in the Record and Information Manuals.

B. Disposal of other materials shall be in accordance with State and Local regulations.

C. Cleanup
   1. Leave inside of building “broom clean” in all areas.
   2. Remove barricades as directed.

END OF SECTION 26 00 25

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.2 DEFINITIONS

A. VFD: Variable frequency drive.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers:

1. Alcan Products Corporation; Alcan Cable Division.
2. Alpha Wire.
3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. Okonite
7. Southwire Incorporated.

B. **Aluminum and Copper** Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation:
1. Type THW-2
2. Type THHN-2-THWN-2
3. Type XHHW-2
4. **Type UF Type USE**
5. **Type SO.**

D. Multiconductor Cable:
1. Type MC metal-sheathed cable, with ground wire.
2. Type MI nonmetallic-sheathed cable,
3. **Type NM**
4. **Type SO**
5. **Type USE with ground wire.**

E. VFD Cable:

1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.
2. Type TC-ER with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.
3. Comply with UL requirements for application.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers:

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Wire size shall meet or exceed the overcurrent device ampacity as required by NFPA 70. Where wire size shown on drawings is larger than the apparent ampacity requirements the size shown should prevail to account for voltage drop. The minimum conductor size shall be #12 AWG except for control wiring, which may be #14 AWG.

B. Conductors: Copper, solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Conductors: Aluminum feeders may be utilized for No. 4 AWG and larger, only. Copper for feeders and branch circuits smaller than No. 4 AWG. Solid conductors for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance may utilize the following:
1. Type THHN-2-THWN-2, single conductors in raceway
2. Type XHHW-2, single conductors in raceway
3. **Mineral-insulated, metal-sheathed cable, Type MI**

4. **Type SE**
5. **Type USE, multiconductor cable**

B. Exposed Feeders may utilize the following:
1. Type THHN-2-THWN-2, single conductors in raceway
2. Type XHHW-2, single conductors in raceway
3. **Metal-clad cable, Type MC**
4. **Mineral-insulated metal-sheathed cable Type MI.**

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces:
1. Type THHN-2-THWN-2, single conductors in raceway
2. **Metal-clad cable, Type MC**
3. **Mineral-insulated, metal-sheathed cable, Type MI**
4. **Nonmetallic-sheathed cable, Type NM.**

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground:
1. Type THHN-2-THWN-2, single conductors in raceway
2. Type XHHW-2, single conductors in raceway
3. **Underground feeder cable, Type UF.**

E. Feeders Installed below Raised Flooring:
1. Type THHN-2-THWN-2, single conductors metal raceway
2. **Metal-clad cable, Type MC**
3. **Mineral-insulated, metal-sheathed cable, Type MI.**

F. Feeders in Cable Tray:
1. Type TC-ER tray cable, single or multiple conductor,
2. Mineral-insulated, metal-sheathed cable, Type MI

G. Exposed Branch Circuits, Including in Crawlspaces:
1. Type THHN-2-THWN-2, single conductors in raceway
2. Metal-clad cable, Type MC
3. **Mineral-insulated, metal-sheathed cable, Type MI**
4. **Nonmetallic-sheathed cable, Type NM.**

H. Branch Circuits Concealed in Ceilings, Walls, and Partitions:
1. Type THHN-2-THWN-2, single conductors in raceway
2. Metal-clad cable, Type MC
3. **Mineral-insulated, metal-sheathed cable, Type MI**
4. **Nonmetallic-sheathed cable, Type NM.**

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground:
1. Type THHN-2-THWN-2, single conductors in raceway
2. Type XHHW-2, single conductors in raceway
3. **Underground branch-circuit cable, Type UF.**

J. Branch Circuits Installed below Raised Flooring:
1. Type THHN-2-THWN-2, single conductors in raceway
2. Metal-clad cable, Type MC
3. **Mineral-insulated, metal-sheathed cable, Type MI.**

K. Branch Circuits in Cable Tray:
1. Type TC-ER single and multiple conductors,
2. Mineral-insulated, metal-sheathed cable, Type MI

L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

M. VFD Output Circuits:
   1. **Type XHHW-2 in metal conduit**
   2. **Type TC-ER cable with braided shield with dual tape shield.**

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. MC Cable may be used for branch circuiting to wiring devices provided it is supported properly and run taut. MC must transition to other approved wire types prior to leaving the room it is permitted in. MC may not be used for home-runs.

B. MC Cable may be used for lighting fixture whips, no longer than 6’-0” and shall be properly supported.

C. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

D. All feeder and branch circuits shall be ran with dedicated neutral conductors (shared neutrals not permitted).

E. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

F. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

G. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

H. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

I. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

J. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material.

   1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

A. Contractor shall perform insulation resistance (IR) tests, commonly called “megger” tests on any feeder or circuit which may have been damaged during installation or where identified as questionable by the Architect or Engineer. Test shall be performed according to standards published by ANSI/NETA.

B. Testing Agency: **Owner will** Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:

1. After installing conductors and cables and before electrical circuitry has been energized, test **service entrance and feeder conductors and conductors feeding the following critical equipment and services** for compliance with requirements.

    a. **Insert, in separate subparagraphs, critical equipment and services to be tested**.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

E. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

F. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 05 19

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.2 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Instructions for periodic testing and inspection of grounding features.

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
2) Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Comply with UL 467 for grounding and bonding materials and equipment.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning and Grounding.
7. ILSCO.
8. Newton Instument Company.
9. O-Z/Gedney; A Brand of the EGS Electrical Group.
10. Robbins Lightning, Inc.
11. Siemens Power Transmission & Distribution, Inc.

2.2 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable unless otherwise required by applicable Code or authorities having jurisdiction. Conductors shall be identified by green insulation or by applying green tape at accessible locations.

B. Bare Copper Conductors: Copper or tinned wire solid or stranded conductors.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, minimum 1/4” by 4 inches by 20 inches and, with 3/8-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.3 CONNECTORS

A. UL Listed and acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad, 3/4 inch by 10 feet. Provide sectional ground rods as needed.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

B. Grounding Bus: Install in electrical equipment rooms, telecom rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Exothermic welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to all other Ground Rods: Exothermic welded connectors.
5. Connections to Structural Steel: Exothermic welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Grounding electrode shall include, at a minimum, driven rod(s), metallic water piping system, concrete encased reinforcing steel, and structural steel. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. In addition to the complete metal conduit system, install insulated equipment grounding conductors with all feeders and branch circuits. Minimum equipment grounding conductor size shall be #12 AWG.

B. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

C. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than **No. 6** AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

D. Motor frames shall be bonded to the equipment grounding system by an independent ground wire, sized to match the equipment grounding conductor.

3.4 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: On 480V systems with ground-fault protection at the main overcurrent device, Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor, to the frame of the generator, and bonded to the generator system neutral conductor. On 208V systems without ground-fault protection at the main overcurrent device, install ground rod at the generator location. The ground rod shall be connected to the frame of the generator with #6 AWG copper supplemental grounding electrode.

B. Pad-Mounted Transformers: Install grounding electrode. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to grounding electrodes. Bond the high voltage neutral, cable shields, conduits, and low voltage neutral.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 6 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least **three** rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260581 "Manholes, Handholes, and Underground Pull Boxes," and shall be at least 12 inches deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 70 feet apart.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:
    1. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: **5** ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RGC: Rigid Galvanized Conduit.

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

1.4 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.
b. Eaton's B-Line Series – Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Atkore International.

g. Wesanco, Inc.

2. Supports shall be hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Where installed outdoors or subject to corrosion stainless steel supports shall be provided.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Raceway Support Methods: In addition to methods described in NECA 1, metallic raceways may be supported by openings through structure members, as permitted in NFPA 70.

B. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick. Powder-actuated fasteners may not be used in occupied buildings.
6. To Steel: Welded threaded studs with lock washers and nuts, Beam clamps, or Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

2. See additional requirements where painting specification are included as part of this project.

3. Where finish painting is not included in the general trades contract, or when the Electrical Contractor is the sole contractor, provide prime coat and two finish coats of paint to all ferrous metal which is not galvanized.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780 / A780M.

END OF SECTION 26 05 29

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SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Floor boxes and poke-thru devices.

1.2 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. FMC: Flexible Metal conduit.

C. RGC: Rigid galvanized threaded steel conduit.

D. HDPE: High Density Polyethelene.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquid-Tight Flexible metal conduit.

G. RNC: Rigid Nonmetallic Conduit.

1.3 ACTION SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. Anamet Electrical, Inc.
4. Carlon
5. Cantex
6. Champion
7. Electri-Flex Company.
8. O-Z/Gedney.
9. Picoma Industries.
10. Republic Conduit.
11. Robroy Industries.
12. Southwire Company.
13. Thomas & Betts Corporation.
14. Western Tube and Conduit Corporation.
15. Wheatland Tube Company.

B. Listing and Labeling: Conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CONDUIT TYPES - APPLICATIONS AND RESTRICTIONS:

A. RGC: Comply with ANSI C80.1 and UL 6.
1. Not to be used in corrosive atmospheres.

B. IMC: Comply with ANSI C80.6 and UL 1242.
1. Not to be used in corrosive atmospheres.

C. PVC-Coated Steel Conduit: PVC-coated **RGC, IMC**. Comply with NEMA RN 1. Coating thickness 0.040 inch, min.
1. For use in utility tunnels and other corrosive atmospheres.

D. ARC: Comply with ANSI C80.5 and UL 6A.
1. For use in utility tunnels and other corrosive atmospheres.
2. Not to be used in contact with concrete

E. RTRC Fiberglass: Comply with UL 1684A and NEMA TC 14.
   1. For use underground, direct buried or encased in concrete.
   2. For use in utility tunnels or corrosive atmospheres.

F. RNC: Type PVC Schedule 40, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
   1. For use underground, direct buried or encased in concrete.

G. EMT: Comply with ANSI C80.3 and UL 797.
   1. Not to be used underground or where exposed to weather.
   2. Not to be used in utility tunnels or corrosive atmospheres.

H. FMC: Comply with UL 1; zinc-coated steel or aluminum.
   1. For use with fixture whips and lighting fixtures (6' max).
   2. For connections to dynamic equipment and connections to motors in airstream.
   3. For use in existing walls.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
   1. For use under raised floors.
   2. For connections to motors except where protection from physical damage is needed (in air stream).
   3. For use in wet locations.

J. Rigid HDPE: Comply with UL 651A.
   1. For use underground, direct buried, or where directional drilling is permitted.

K. ENT: Comply with NEMA TC 13 and UL 1653.
   1. For use with telecommunications cabling and fiber optic cable, indoors where not exposed to physical damage.

2.3 CONDUIT FITTINGS:

A. Manufacturers: Subject to compliance with requirements, provide products equal to one of the following.
   1. Appleton
   2. Cooper Industries
   3. Efcor
   4. Steel City
   5. T&B
   6. By Raceway Manufacturer
   7. or equal.

B. Metallic fittings shall comply with NEMA FB 1 and UL 514b.

C. All fittings shall be UL listed for the application.

D. RGC, ARC, and IMC
   1. Conduit Fittings for Hazardous (Classified) Locations: Threaded, comply with UL 886 and NFPA 70. Provide seal-off's where raceway enters hazardous location.
   2. Threaded fittings, malleable iron, with grounding bushing. Cooper Industries #800 series, or equal.
   3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

E. RTRC and RNC (PVC)
   1. Fittings shall be of the same material and manufacturer as the raceway, solvent welded type.

   2. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. EMT:

1. Steel fittings, setscrew type, **non-insulated,insulated throats**, concrete tight. Cooper Industries #450 series, or equal.
2. **Steel fittings, compression type, insulated throats. Cooper Industries #1600 series, or equal.**

G. FMC:
1. Non-insulated, malleable iron, clamp type. Cooper industries #700 series or equal

H. LFMC:
1. Steel or malleable iron. Cooper Industries Liquidator series, LTK series, or equal.

I. ENT:
1. Comply with NEMA TC 3; match to conduit or tubing type and material.

J. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and include flexible external bonding jumper.

K. Joint Compound for RGC, IMC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

L. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 CONDUIT SIZES

A. Minimum Raceway Size 3/4-inch trade size.

2.5 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Cooper B-Line, Inc.
2. Hoffman.
3. Mono-Systems, Inc.
4. Schneider Electric - Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be NEMA 3R, listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: **Hinged type, Screw-cover type, Flanged-and-gasketed type** unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.6 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. **Manufacturer's standard enamel finish in color selected by Architect, Prime coated ready for field painting to match installed surface.**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design product.

    a. Mono-Systems, Inc.
    b. Panduit Corp.
    c. Wiremold / Legrand.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from **manufacturer's standard custom** colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of Design product.

    a. Hubbell Incorporated.
    b. Mono-Systems, Inc.
    c. Panduit Corp.
    d. Wiremold / Legrand.

D. Tele-Power Poles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design product.

    a. Mono-Systems, Inc.
    b. Panduit Corp.
    c. Wiremold / Legrand.

2. Material: **Galvanized steel with ivory baked-enamel finish, Aluminum with clear anodized finish**.
3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.7 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Adalet.
2. Eaton
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman.

7. Hubbell Incorporated.
8. Kraloy.
9. Milbank Manufacturing Co.
10. Mono-Systems, Inc.
11. O-Z/Gedney.
12. RACO; Hubbell.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A. Boxes shall be galvanized or plated finish.

D. Cast-Metal Outlet and Device Boxes: For use in surface mounted applications. Comply with NEMA FB 1, Type FD, with gasketed cover.

E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

F. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Device Box Dimensions: 4 inches square or octagonal by 2-1/8 inches deep. Provide extension rings as required for recessed boxes.

J. Gangable boxes are prohibited.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 for indoor application, Type 3R for outdoor applications (unless otherwise noted on drawings), with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:

1. NEMA 250, Type 1 for indoor application, Type 3R for outdoor applications (unless otherwise noted on drawings), galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.8 FLOOR BOXES AND POKE-THRU DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. FSR Inc.
2. Hubbell Incorporated.
3. Kraloy.
4. Mono-Systems, Inc.
5. RACO; Hubbell.
6. Thomas & Betts Corporation.
7. Wiremold / Legrand.

B. Metal Floor Boxes:

1. Material: Steel, designed for on-grade installation.
2. Type: Fully adjustable, multi-service (power and telecom), multi-gang. Refer to drawings for wiring device quantity and type.
3. **Devices shall be concealed beneath cover (recessed type box), Devices shall be flush mounted on cover (flush type box).**
4. Shape: Rectangular.
5. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Cover: Provide metal cover with finished floor insert.
7. Floor boxes shall be compatible with standard wiring device types and low voltage modular jacks.

C. Nonmetallic Floor Boxes: Nonadjustable, round or rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Refer to drawings for wiring device quantity and type.

D. Poke-Thru Devices:

1. Material: Sheet metal formed device box.
2. Type: Multi-service (power and telecom), multi-gang. Refer to drawings for wiring device quantity and type.
3. Listing and Labeling: Device shall be UL listed and classified for use in fire rated floors.
4. Cover: Provide flush metal cover with modular device outlets.
5. Devices shall be compatible with standard wiring device types and low voltage modular jacks.

PART 3 - EXECUTION

3.1 INSTALLATION

A. PVC Externally Coated, Rigid Steel Conduits: Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

B. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

C. Install surface raceways only where indicated on Drawings.

D. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F .

E. Do not utilize non-ferrous conduit systems or raceway components for motor circuit conductors for variable speed drives. All portions of VFD raceway systems shall be comprised of ferrous materials and provide a continuously grounded pathway to prevent unintentional RF emissions from motor circuit cables.

F. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

G. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

H. Complete raceway installation before starting conductor installation.

I. Arrange stub-ups so curved portions of bends are not visible above finished slab.

J. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

K. Conduit shall be run overhead unless specifically shown on drawings to run under the slab.

L. Conceal raceways within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

M. Support conduit within 12 inches of enclosures to which attached.

N. Raceways Installed Below Slabs:
1. Where **feeders and branch circuits** are permitted to run below slabs they should be installed in non-metallic conduit and encased in 3” envelope of concrete. Provide 6” layer of over fill above encasement.
2. Conduits shall not be installed above the vapor barrier.
3. Transition from RNC-PVC to **RGC or IMC** before rising above floor.
4. **PVC conduit is prohibited below slabs in patient care areas. Comply with the requirements of NEC 517.13.**

O. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

P. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

Q. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

R. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

S. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to **1-1/4-inch** trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

T. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

U. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

V. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

W. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

X. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

Y. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

Z. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

AA. Expansion-Joint Fittings:

1. Install in each run of aboveground conduit crossing building expansion joints. Maintain grounding continuity. Refer to architectural plans for locations or expansion joints.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to **top** of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

EE. Locate boxes so that cover or plate will not span different building finishes.

FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

HH. Floor Boxes and Poke-Thru Devices:

1. Provide dummy cover to protect equipment during construction and concrete pour.
2. Unused openings in floor boxes shall be sealed prior to concrete pour.

3.2 CONDUIT SUPPORT

A. Secure feeder conduit to basic structural elements with galvanized strap hangers and clamps; use of trapeze type hangers is encouraged for multiple conduits where space will permit. Galvanized metal clamps and screws may be used for attaching and supporting branch circuit conduit. Nonmetallic fasteners shall not be used except plastic inserts may be used in concrete for small conduits.

B. Vertical conduits shall be supported at each floor by clamps.

3.3 ANCHORS AND FASTENERS

A. Anchors and fasteners shall be of a type designed and intended for use in the base material to which the material support is to be attached and shall be capable of supporting the intended load and withstanding any associated stresses and vibrations.

B. In general, screws shall be used in wood, masonry anchors on concrete or brick, toggle bolts in hollow walls, and machine screws, bolts or welded studs on steel.

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.5 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Direct-buried conduit, ducts, and duct accessories.
2. Concrete-encased conduit, ducts, and duct accessories.

1.2 RELATED DOCUMENTS

A. Section 26 05 33 “Raceways and Boxes for Electrical Systems” for commonly used electrical conduit types, fittings, and adhesives.

1.3 DEFINITIONS

A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 INFORMATIONAL SUBMITTALS

A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
2. Drawings shall be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils.
3. Weight: 18.5 lb/1000 sq. ft.
4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

PART 3 - EXECUTION

3.1 APPLICABILITY

A. Motor circuit conductors associated with variable frequency drives shall not be installed in non-ferrous raceways below grade unless shielded VFD cables are utilized.

3.2 PREPARATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

3.3 EARTHWORK

A. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

B. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."

C. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" Article in Section 017300 "Execution."

3.4 DUCT INSTALLATION

A. Install ducts according to NEMA TCB 2.

B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.

C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of **48 inches**, both horizontally and vertically, at other locations unless otherwise indicated.

D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

E. Installation Adjacent to High-Temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, perform calculations showing the duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

F. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4 inch .
3. Grout end bells into structure walls from both sides to provide watertight entrances.

G. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

H. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

I. Pulling Cord: Install 100-lbf- test nylon cord in empty ducts.

J. Duct Construction:

1. Excavate trench bottom to provide firm and uniform support for duct bank.
2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
3. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts. Secure separators to earth and to ducts to prevent floating during fill. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
4. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
5. Elbows: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
    a. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of **60 inches** from edge of base. Install insulated grounding bushings on terminations at equipment.

K. Concrete Encasement:
1. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
2. Concrete Cover: Install a minimum of 3 inches of concrete cover at top and bottom, and a minimum of 3 inches on each side of duct bank.
3. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.

b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.

4. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
5. Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
6. Place minimum 6 inches of engineered fill above concrete encasement of duct bank.

L. Direct-Buried Duct Banks:

1. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

a. Place minimum 3 inches of sand as a bed for duct bank. Place sand to a minimum of 6 inches above top level of duct bank.

M. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.

N. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches . Space additional tapes 12 inches apart, horizontally.

3.5 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch- long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.7 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Exposed Raceways:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Colors for Concealed Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

D. Snap-Around Labels for Raceways: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action. Provide at all splice or junction boxes and at 30’ maximum intervals.

E. Tape and Stencil for Concealed Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends. Provide legend at 30’ maximum intervals.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Self-Adhesive, Self-Laminating Polyester Labels: Write-on, 3-mil thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend. Provide label at each termination point.

C. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide. Provide at each field splice and termination point.

2.3 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. Multiple Electric Service Warning: “DANGER – BUILDING IS SERVED BY MULTIPLE ELECTRICAL SOURCES” Followed by a description of location and area with floor plan.
4. Emergency Sources Warning: “DANGER – AN ONSITE EMERGENCY GENERATOR IS LOCATED ‘XXX’.

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16-inch-thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background. Minimum letter height shall be 3/8 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Apply only to finished surfaces.

B. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

C. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

D. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

E. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

B. At each junction box and splice box provide pre-printed self-adhesive labels to identify system, voltage, and/or source panel/circuit numbers.

C. At each wiring device cover plate provide pre-printed self-adhesive labels to identify source panel/circuit numbers.

D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

F. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting:
1. Identify system voltage with black letters on an orange background.
2. Apply to exterior of door, cover, or other access.
3. For equipment with multiple power or control sources, identify all sources:

a. Power transfer switches.
b. Controls with external control power connections.

H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for **[Power Transfer] and [Load Shedding] and [any other emergency loads].**

J. Electrical Service Equipment: Electrical service equipment shall be provided with an equipment label identifying the available fault current and date calculation was performed, at the equipment bus.

K. Multiple Electric Service Warning: Where a building is fed from multiple electrical services a permanent plaque or directory shall be placed at each service disconnect location denoting all other services supplying that building and the area of the building served by each service disconnect, complying with NEC 230.2(E).

L. Emergency Sources Warning: A warning sign shall be placed at the electrical service equipment identifying type and location of on-site emergency power sources, complying with NEC 700.7.

M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual.

1. Labeling Instructions:

a. Provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
c. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Switchgear.
e. Switchboards.

f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
g. Substations.
h. Emergency system boxes and enclosures.
i. Motor-control centers.
j. Enclosed switches.
k. Enclosed circuit breakers.
l. Enclosed controllers.
m. Variable-speed controllers.
n. Push-button stations.
o. Power transfer equipment.
p. Contactors.
q. Remote-controlled switches, dimmer modules, and control devices.
r. Battery-inverter units.
s. Battery racks.
t. Power-generating units.
u. Monitoring and control equipment.
v. UPS equipment.

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SECTION 26 05 81

MANHOLES, HANDHOLES AND UNDERGROUND PULL BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes manholes, handholes, and underground pull boxes.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work in compliance with ASTM, and applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. Manufacturer Qualifications: Manufacturers of pre-cast manholes shall be firms regularly engaged in manufacturing factory fabricated manholes, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

C. Manholes shall be factory fabricated of reinforced concrete and in conformance with American National Standards Institute (ANSI) C 2, "National Electrical Safety Code (NESC)" and applicable requirements of American Society of Testing Materials (ASTM) C 478, "Specifications for Pre-cast, Reinforced Concrete Manhole Sections." Manhole structure shall be designed in accordance with requirements of the American Association of State Highway and Transportation Officials (AASHTO) publication "Standard Specifications for Highway Bridges." AASHTO H20 highway loading shall apply with 30 percent loading added for impact.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Precast Manholes and Handholes.
   1. Oldcastle Precast, Inc.
   2. Norwalk Concrete Industries
   3. Shea Concrete Products
   4. Smith-Midland Corp.

B. Manhole and Handhole Frames and Covers
   1. East Jordan (EJ) Iron Works, Inc.
   2. Campbell Foundry Co.
   3. McKinley Iron Works
   4. Neenah Foundry Co.

C. Cable Racks
   1. Underground Devices Incorporated.
   2. Hubbell Power Systems, Inc.
   3. Or equivalent.

D. Pull Boxes.
   1. Quazite by Hubbell

2. Syntertech by Oldcastle
3. MacLean Highline

2.2 MATERIALS

A. Pre-cast Manholes and handholes
1. Manhole dimensions shall be 6'x6'x8' minimum inside unless otherwise indicated on the drawings.
2. Handhole dimensions shall be 4'x4'x4' minimum unless otherwise indicated on the drawings.
3. Manhole and handholes shall be pre-cast unit consisting of two interlocking, mating sections, complete with accessory items, hardware, and features as indicated including concrete knockout panels for conduit entrance and sleeve for ground rod.
4. Joint sealant for joints between pre-cast sections shall be continuous extrusion of asphaltic butyl material compounded for the adhesion, cohesion, flexibility, and durability properties required for a permanent seal.

B. Manhole and Handholes Hardware and Accessories
1. Frames and covers shall be cast iron conforming to American National Standards Institute (ANSI) C2, "National Electrical Safety Code," Rule 323, AASHTO H-20 with 30% service factor. Furnish with cast in legend, **"High Voltage",** "**Electric", or "Telecom**" Cover to frame bearing surfaces machined.
2. Sump frame and grate shall comply with A-A-60005, Type VII (Sump Frame) for frame, Type I (Straight Traffic Frame) for cover. Locate sump at center of manhole directly below the cover.
3. Pulling eyes in walls shall be with rebar fastening insert. Working load embedded in 6 inch, 4,500 pounds per square inch (psi) concrete: 13,000 pounds minimum tension.
4. Bolting inserts for cable stanchions shall be flared, threaded inserts of noncorrosive, chemical resistant, nonconductive thermoplastic material. One-half inch internal diameter by 2 3/4 inches deep, flared to 1-1/4 inch minimum at base. Tested ultimate pull out strength: 12,000 pounds, minimum.
5. Expansion anchors for installation after concrete is cast shall be zinc plated carbon steel wedge type with stainless steel expander clip 1/2 inch bolt size, 5,300 pound rated pull out strength, and 6,800 pound rated shear strength, minimum.
6. Manhole cable support rack: heavy duty non-metallic rack, and support arms on each side wall.
7. Provide duct entry knockouts on each side.
8. Provide radius bell ends on all conduits in manholes.
9. Provisions for grounding. Provide exothermic T weld for 4/0 cable entering manhole from each duct bank. Conductors from each duct bank must be exothermic welded together for a continuous grounding path to the source. Provide 4/0 cable tap from the duct bank T weld to a 3" x 18" x ¼" ground bar mounted on or near the ceiling of the manhole using standoff insulators. Attach all grounds entering the manhole to the ground bar using listed 2-hole compression lugs, antioxidant compound, bronze bolts and Bellville washers.
10. Refer to manhole and handhole details for further requirements.

C. Underground Pull Boxes
1. Underground pull boxes shall be factory fabricated of fiberglass reinforced polymer concrete. Boxes shall be stackable with minimum dimensions:
   1. **11" W x 18" L x 16" D**
   2. **17" W x 30" L x 16" D.**

2. Covers: Provide heavy duty covers, Tier 15 rated for a service load of 15,000 pounds over a 10-inch square area. Covers shall read "High Voltage", "Electric", or "Telecom" as indicated. Covers shall be secured with stainless steel penta-head bolts.
3. Openings: Openings shall be provided for duct number and size as indicated on plan.

D. Ladder
1. Fiberglass manhole ladder, specifically designed for electrical manhole use. Minimum length equal to the distance from the deepest manhole floor to grade, + 3 feet. Supply one ladder at every manhole.

E. Raceway/Duct Sealing Compound
1. Compound shall be nonhardening, putty like consistency workable at temperatures as low as 35^0 F. Compound shall not slump at a temperature of 300^0 F. and shall readily adhere to clean surfaces of plastic ducts, metallic conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and the common metals. Compound shall have no injurious effect on worker's hands and materials.

F. Extra Materials
1. Furnish the following extra materials matching products installed, packaged with protective covering for storage and with identification labels clearly describing contents.
2. Cable stanchions, support arms, insulators, and associated fasteners in the quantity of 10 percent of those installed for actual use in this project.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Provide manholes, handholes, and underground pull boxes of sizes, and shapes as indicated. Determine final grading of ducts as influenced by possible adjustments in other utilities and surface features and discovery of underground obstructions before installing manholes, handholes, and underground pull boxes, **coordinate with Civil Engineer**. Install units plumb and level and with orientation and depth coordinated with arrangement of connecting ducts to minimize bends and deflections required for proper entrances.

B. Install manholes and handholes in approximate locations shown on plans in accordance with manufacturer's written instructions. Coordinate exact location with other utilities grading, paving and owner's representative.

C. Duct Entrances to Manholes and Handholes: End bells spaced approximately 10 inches center to center for 5 inch ducts (5" typical or is 4") and varied proportionately for other duct sizes. The change from regular spacing to end bell spacing shall start 10 feet from the end bell and shall be made without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances. Slope ducts away from building, towards manhole.

D. Drainage: Install drains in bottom of units where indicated. Arrange to coordinate with drainage provisions indicated or specified.

E. Precast Access: Install access to manhole and handholes through cast iron frame and cover. Use 36" diameter cover except as indicated. Install precast concrete rings and seal with joint sealant as described in Part 2 of this specification. In addition, caulk all seams and joints inside and out. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.

F. Waterproofing: Apply waterproofing to exterior surfaces of units after concrete has cured at least 3 days. After ducts have been connected and grouted in, and prior to backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after brick mortar has cured at least 3 days.

G. Field Installed Bolting Anchors: Do not drill deeper than 3 7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

H. Manholes provisions for future duct(s) to consist of formed opening(s) with structural steel placed around to permit easy knockout of opening in future.

3.2 INSTALLATION OF PRECAST MANHOLES, HANDHOLES, AND UNDERGROUND PULL BOXES

A. Install in accordance with ASTM C 891, "Standard Practice for Installation of Underground Precast Concrete Utility Structures," and manufacturer's instructions.

B. Support units on a minimum 12 inch deep level bed of #8 crushed stone.

C. Compact backfill as required to set units securely in place. Backfill and grading shall be sloped to drain surface water away from access covers.

3.3 CLEANING AND RESTORATION

A. Clean all internal surfaces including sump. Remove all foreign material.

B. All manholes, handholes, and pull boxes shall be field inspected prior to acceptance by the Owner. Contractor shall be responsible for pumping manholes, handholes, and pull boxes to allow access for inspection.

END OF SECTION 26 05 81

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Time Clock.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching controls.
4. Indoor occupancy sensors.
5. Outdoor motion sensors.
6. Lighting contactors.
7. Emergency shunt relays.

PART 2 - PRODUCTS

2.1 TIME CLOCK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Intermatic, Inc.
2. Paragon Time Controls
3. Emersion Network Power; ASCO Lighting Control
4. NSi Industries LLC; TORK Products.

B. Electronic Time Clock: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: single pole, single throw (SPST) or as indicated on the drawings.
3. Contact Rating: 20-A ballast load, 120-/240-V ac. Provide inductive load rated contact where shown on drawings to control motor loads.
4. Programs: Minimum, two on-off set points on a 24-hour schedule, allowing different set points for each day of the week**.**
5. Automatic daylight savings time changeover.
6. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Intermatic, Inc.
2. NSi Industries LLC; TORK Products.
3. Leviton
4. Sunrise Technologies

B. Description: Solid state, with dry contact rated for 1800-VA, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range**,** and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 DAYLIGHT-HARVESTING SWITCHING CONTROLS (NON-DIMMING)

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

1. Cooper Industries, Inc.
2. Eaton Corporation.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lithonia Lighting; Acuity Brands Lighting, Inc.
6. NSi Industries LLC; TORK Products.
7. Sensor Switch, Inc.
8. Tyco Electronics; ALR Brand.
9. Watt Stopper.

B. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.

C. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.
4. Power Pack: Dry contacts rated for **20** -A ballast load at 120- and 277-V ac, and for **1** hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc , with an adjustment for turn-on and turn-off levels within that range.
6. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc, with an adjustment for turn-on and turn-off levels within that range.
7. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc , with an adjustment for turn-on and turn-off levels within that range.
8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
10. Test Mode: User selectable, overriding programmed time delay to allow settings check.
11. Control Load Status: User selectable to confirm that load wiring is correct.
12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.4 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Leviton Mfg. Company Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.

5. Watt Stopper.

B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present (target level).
b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.
b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
4. Light-Level Sensor Set-Point Adjustment Range: **20 to 60 fc**.

2.5 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.; Greengate
2. Hubbell Building Automation, Inc.
3. Leviton Manufacturing Co., Inc.
4. Lutron Electronics Co., Inc.
5. Sensor Switch, Inc.
6. Watt Stopper.

B. Devices Types: Devices located in stairwells shall be ultrasonic type. All other locations shall be dual-technology (PIR and Ultrasonic) type, unless otherwise noted on drawings or in this specification.

C. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast/driver load at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.
b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
9. **Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.**

D. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating:
   a. Line Voltage Units: Not less than 800-VA fluorescent or LED at 120 V, 1200-VA fluorescent or LED at 277 V.
   b. Low Voltage Units: Suitable for use with relay-based lighting control system. Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack relay.
4. **Onboard 0-10V dimming control (sinking) with integral rocker switch for adjusting light levels up/down.**

E. General Requirements for Sensors: High-bay occupancy sensor, solid-state unit. The unit is designed to operate with the luminaires indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Turn lights on when coverage area is occupied, and to half-power when unoccupied; with a time delay for turning lights to half-power that is adjustable over a minimum range of 1 to 16 minutes.
3. Continuous Lamp Monitoring: When lamps are dimmed continuously for 24 hours, automatically turn lamps on to full power for 15 minutes for every 24 hours of continuous dimming.
4. Operating Ambient Conditions: 32 to 149 deg F.
5. Mounting: Threaded pipe.
6. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
7. Detector Technology: PIR.
8. Detector Coverage: User selectable by interchangeable PIR lenses, suitable for mounting heights from **12 to 50 feet.**
9. Accessories: Obtain manufacturer's installation and maintenance kit with laser alignment tool for sensor positioning and power port connectors.

F. General Requirements for Sensors: Extreme Temperature ceiling-mounted, solid-state, extreme-temperature occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application in damp locations.
2. Operation: Turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
3. Operating Ambient Conditions: From **minus 40 to plus 125 deg F.**
4. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
5. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
6. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind cover.

7. Bypass Switch: Override the "on" function in case of sensor failure.
8. **Automatic Light-Level Sensor: Adjustable from 2 to 10 fc; keep lighting off when selected lighting level is present.**

2.6 OUTDOOR MOTION SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.; Greengate
2. Hubbell Building Automation, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC; TORK Products.
5. Sensor Switch, Inc.
6. Watt Stopper.

B. General Requirements for Sensors: Solid-state outdoor motion sensors.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application**, and shall comply with California Title 24**.
2. **Dual-technology** type, weatherproof. Comply with UL 773A.
3. Switch Rating:

   a. Lighting-Fixture-Mounted Sensor: **500-VA fluorescent/LED**.
   b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
4. Voltage: Match the circuit voltage
5. Detector Coverage:

   a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
   b. Long Range: 180-degree field of view and 110-foot detection range.
6. **Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.**
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
9. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

2.7 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP.
3. Eaton Corporation.
4. General Electric Company;
5. Square D.
6. Siemens

B. Description: Electrically operated and **mechanically** held, combination-type lighting contactors complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served.
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.

3. Enclosure: Comply with NEMA 250, hinged enclosure with HOA switch installed in the door. All control wiring shall be wired through the automatic control position.

C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.

2.8 EMERGENCY SHUNT RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Watt Stopper.
2. Bodine
3. Cooper Greengate
4. Lutron

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 or 277V.

2.9 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than **No. 22** AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than **No. 14** AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

B. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: **Owner will engage**, **Engage** a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within **twelve (12)** months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to **two (2)** visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.6 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."

B. **Train** Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 09 23

SECTION 26 09 43

RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lighting control panels using mechanically held relays for switching.
2. Networked lighting control panels using control-voltage relays for switching and that are interoperable with BAS.
3. Manual switches and plates.
4. Field-mounted signal sources
5. Cables and wiring
6. Plug-Load receptacle control

1.2 DEFINITIONS

A. BAS: Building automation system.

B. IP: Internet protocol.

C. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

D. PC: Personal computer; sometimes plural as "PCs."

E. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.

1.3 ACTION SUBMITTALS

A. Shop Drawings: For each relay panel and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail wiring partition configuration, current, and voltage ratings.
4. Short-circuit current rating of relays.
5. Include diagrams for power, signal, and control wiring.
6. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.

1. Show interconnecting signal and control wiring, and interface devices that prove compatibility of inputs and outputs.
2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the network protocol.

B. Qualification Data: For testing agency.

C. Field quality-control reports.

D. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.

E. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lighting Control Relays: Equal to ONE (1) percent of amount installed, but no fewer than TWO (2).

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Input signal from field-mounted manual switches, or digital signal sources, shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with UL 916.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Lighting control panels shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7**.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified **and the unit will be fully operational after the seismic event**."
2. Component Importance Factor: **1.5, 1.0**.
3. <**Insert requirements for Component Amplification Factor and Component Response Modification Factor**>.

B. BAS Interface: Provide hardware and software to enable the BAS to monitor, control, display, and record data for use in processing reports.

1. Hardwired Points:

a. Monitoring: On-off status, <**Insert monitoring point**>.
b. Control: On-off operation, <**Insert control point**>.

2. Communication Interface: Comply with **ASHRAE 135**. The communication interface shall enable the BAS operator to remotely control and monitor lighting from a BAS operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the BAS.

2.3 MANUFACTURERS

A. Source Limitations: Obtain all components, sensors, wall switches, and control panels from single source from single manufacturer. Where specific manufacturer is named on the drawings, this manufacturer shall be the basis-of-design manufacturer.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Crestron
2. Hubbell
3. Legrand
4. Leviton
5. Lighting Control & Design (LC&D)
6. Lutron
7. nLight
8. Pass & Seymour
9. Steinel
10. Watt Stopper

2.4 LIGHTING CONTROL RELAY PANELS

A. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.

B. Lighting Control Panel:

1. A single central enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
2. A vertical barrier separating branch circuits from control wiring.

C. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.

1. Timing Unit:

a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
c. Minimum of FOUR independent schedules, each having TWENTY FOUR time periods.
d. Schedule periods settable to the minute.
e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
f. TEN special date periods.

2. Sequencing Control with Override:

a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
d. Override control "blink warning" shall warn occupants approximately **FIVE** minutes before actuating the off sequence.

3. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation, including accurate time of day and date.

D. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating shall be not less than 5 kA. Control shall be three-wire, 24-V ac.

E. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and photo sensors.

F. Operator Interface:

1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
2. Log and display relay on-time.
3. Connect relays to one or more time and sequencing schemes.

2.5 NETWORKED LIGHTING CONTROL PANELS

A. Description: Lighting control panels using mechanically latched relays to control lighting and appliances. The panels shall be capable of being interconnected with digital communications to appear to the operator as a single lighting control system.

B. Lighting Control Panels:

1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.

2. A vertical barrier separating branch circuits from control wiring.

C. Main Control Unit:

1. Ethernet Communications: Comply with **MS Windows, TCP/IP** protocol. The main control unit shall provide for programming of all control functions of the main and all networked slave lighting control panels including timing, sequencing, and overriding.
2. Compliance with ASHRAE 135: Controllers shall support serial MS/TP and Ethernet IP communications, and shall be able to communicate directly via BAS RS-485 serial networks and Ethernet 10Base-T networks as a native device.
3. Web Server: Display information listed below over a standard Web-enabled server for displaying information over a standard browser.

    a. A secure, password-protected login screen for modifying operational parameters, accessible to authorized users via Web page interface.
    b. Panel summary showing the master and slave panels connected to the controller.
    c. Controller diagnostic information.
    d. Show front panel mimic screens for setting up controller parameters, input types, zones, and operating schedules. These mimic screens shall also allow direct breaker control and zone overrides.

4. Timing Unit:

    a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
    b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
    c. Min**. FOUR** independent schedules, each having **TWENTY FOUR** time periods.
    d. Schedule periods settable to the minute.
    e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
    f. **TEN** special date periods.

5. Time Synchronization: The timing unit shall be updated not less than every 24 hour(s) with the network time server.
6. Sequencing Control with Override:

    a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
    b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
    c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
    d. Override control "blinking warning" shall warn occupants approximately **FIVE** minutes before actuating the off sequence.
    e. Activity log, storing previous relay operation, including the time and cause of the change of status.
    f. Download firmware to the latest version offered by manufacturer.

D. Standard Control Unit, Installed in All Lighting Control Panels: Contain electronic controls for programming the operation of the relays in the control panel, contain the status of relays, and contain communications link to enable the digital functions of the main control unit. Comply with UL 916.

1. Electronic control for operating and monitoring individual relays, and display relay on-time.
2. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation.
3. Integral keypad and digital-display front panel for local setup, including the following:

    a. Blink notice, time adjustable from software.
    b. Ability to log and display relay on-time.

c. Capability for accepting downloadable firmware so that the latest production features may be added in the future without replacing the module.

E. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating shall be not less than 5 kA. Control shall be three-wire 24-V ac or digital control network.

F. Power Supply: NFPA 70, Class 2, UL listed, sized for connected equipment, plus not less than 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and low-voltage photo sensors.

G. Operator Interface: At the main control unit, provide interface for a tethered connection of a portable PC running MS Windows for configuring all networked lighting control panels using setup software designed for the specified operating system. Include one portable device for initial programming of the system and training of Owner's personnel. That device shall remain the property of Owner.

H. Software:

1. Menu-driven data entry.
2. Online and offline programming and editing.
3. Provide for entry of the room or space designation for the load side of each relay.
4. Monitor and control all relays, showing actual relay state and the name of the automatic actuating control, if any.
5. Size the software appropriate to the system.

2.6 MANUAL SWITCHES AND PLATES

A. Push-Button Switches: Modular, momentary contact, for operating one or more relays and to override automatic controls.

1. Match color and style specified in Section 262726 "Wiring Devices."
2. Integral green **LED neon** pilot light to indicate when circuit is on.

B. Wall Plates: Single and multigang plates as specified in Section 262726 "Wiring Devices."

C. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.7 FIELD-MOUNTED SIGNAL SOURCES

A. Daylight Harvesting Switching Controls: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

B. Indoor Occupancy Sensors **and Extreme-Temperature Occupancy Sensors**: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

2.8 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than **No. 24** AWG.

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than **No. 14** AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Digital and Multiplexed Signal Cables: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5e for horizontal copper cable.

2.9 PLUG-LOAD RECEPTACLE CONTROL

A. Control relays shall be suitable for use in controlling plug-load receptacles. Refer to plans for signal sources used to control receptacles.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install cables in raceways, cable trays, and/or cable management devices. Conceal raceway and cables except in unfinished spaces. All wiring shall be accessible.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.2 PANEL INSTALLATION

A. Comply with NECA 1.

B. Install panels and accessories according to NECA 407.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Mount top of trim **72 inches** above finished floor unless otherwise indicated.

E. Mount panel cabinet plumb and rigid without distortion of box.

F. Install filler plates in unused spaces.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.

D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: **Owner will engage, Engage** a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Acceptance Testing Preparation:

1. Test continuity of each circuit.

E. Lighting control panel will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform, Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within **12** months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to **two** visits to Project during other-than-normal occupancy hours for this purpose.

3.7 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for **two** years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within **two** years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least **30** days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

A. **Engage a factory-authorized service representative to train, Train** Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION 26 09 43

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SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Disconnecting and overcurrent protective devices.
3. Instrumentation.
4. Control power.
5. Accessory components and features.
6. Identification.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include schematic and wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 2.

E. Comply with NFPA 70.

F. Comply with UL 891.

1.7 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify **Architect Construction Manager Owner** no fewer than **SEVEN** days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without **Architect's, Construction Manager's, Owner's** written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D) or comparable product by one of the following:

1. Eaton
2. GE/ABB
3. Siemens

B. Switchboard shall be free standing, dead front, front-accessibility required. Refer to plans for additional access requirements for each unit; side, rear, front or a combination:

1. Main Devices: Panel Fixed, **individually**, **group** mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Indoor Enclosures: Steel, NEMA 250, Type 1.

E. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

F. Outdoor Enclosures: Type 3R.

1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
2. Enclosure: Rearward sloping roof; bolt-on rear covers for each section, with provisions for padlocking.

3. Doors: Front mounted, hinged and gasketed, with three-point latch. Doors shall swing out and allow unobstructed access to the enclosure interior.
4. **Provide BEST Access Systems locking cylinders with removable 7-pin cores.**
5. Cubical Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
   a. Space-Heater Power Source: **Transformer factory installed in switchboard, external power source**.
   b. Thermostat controlled.

6. Doors: Personnel door at each end of aisle, minimum width of 30 inches opening outwards; with panic hardware and provisions for padlocking cylinder lock.
7. Accessories: Fluorescent lighting fixtures, ceiling mounted; wired to a three-way light switch at each end of aisle; ground-fault circuit interrupter (GFCI) duplex receptacle; emergency battery pack lighting fixture installed on wall of aisle midway between personnel doors.
8. Walk-in Aisle Heating and Ventilating:

   a. Factory-installed electric unit heater(s), wall or ceiling mounted, with integral thermostat and disconnect and with capacities to maintain switchboard interior temperature of 40 deg F with outside design temperature of 32 deg F.
   b. Factory-installed exhaust fan to engage at 80 deg. F, and make-up louver.
   c. Ventilating openings complete with replaceable fiberglass air filters.
   d. Thermostat: Single stage; wired to control heat and exhaust fan.

9. Power for Space Heaters, Ventilation, Lighting, and Receptacle: Include a control-power transformer within the switchboard. Supply voltage shall be **120 120/240 120/208**-V ac.
10. Power for space heaters, ventilation, lighting, and receptacle provided by a remote source.

G. Barriers: Between adjacent switchboard sections.

H. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

I. Customer Metering Compartment: A separate customer metering compartment within front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.

   1. Provide customer metering as specified in section 26 27 13 – Electricity Metering.

J. Removable Rear Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.

K. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

L. Buses and Connections: Three phase, four wire unless otherwise indicated.

   1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity. Busses shall be full height in each section.
   2. Ground Bus: Hard-drawn copper of 98 percent conductivity.
   3. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
   4. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

M. Provide factory-installed, integral Surge Protective Device (SPD); labeled by an NRTL for compliance with UL 67 after installing SPD. Provide Type I device as specified in section 26 43 13 - Surge Protection for Low Voltage Electrical Power Circuits. Device shall be front mounted on hinged door, served from a load side overcurrent protective device, coordinate with SPD manufacture for overcurrent protective device size.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, fully rated to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: For circuit-breaker frame sizes up to 100 A, unless otherwise noted.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting. For circuit breaker frame sizes larger than 100A and
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.

    d. Ground-fault pickup level, time delay, and I^2t response.
4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    e. Communication Capability: **Circuit-breaker-mounted, Universal-mounted Integral Din-rail-mounted** communication module with functions and features compatible with power monitoring and control system specified in Section 26 09 13 "Electrical Power Monitoring and Control."
    f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at **55 75** percent of rated voltage.
    g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    h. Auxiliary Contacts: **One SPDT switch Two SPDT switches** with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
    i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

B. Insulated-Case Circuit Breaker (ICCB): **80, 100** percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:

    a. Instantaneous trip.

b. Long- and short-time time adjustments.
c. Ground-fault pickup level, time delay, and I^2t response.

4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
5. Remote trip indication and control.
6. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 26 09 13 "Electrical Power Monitoring and Control."
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

C. Bolted-Pressure Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers:

a. Boltswitch, Inc.
b. Eaton
c. Pringle
d. Siemens
e. Schneider Electric (Square D).

2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.

a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
4. Service-Rated Switches: Labeled for use as service equipment.
5. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
a. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

E. Fuses are specified in Section 262813 "Fuses."

2.3 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

2.4 IDENTIFICATION

A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.

1. Nameplate: At least 0.032-inch- thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

3.2 INSTALLATION

A. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in other sections.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

C. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: **Owner will engage Engage** a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
   c. Instruments and Equipment:

      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges **as indicated. as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."**

3.6 DEMONSTRATION

A. **Engage a factory-authorized service representative to train Train** Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories**, and to use and reprogram microprocessor-based trip, monitoring, and communication units**.

END OF SECTION 26 24 13

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Electronic-grade panelboards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

C. Panelboard Schedules: For installation in panelboards, schedule shall reflect as-built conditions.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: **Two** spares for each type of panelboard cabinet lock.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Comply with UL 67.

1.6 COORDINATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify **Architect**, **Construction Manager**, or **Owner** no fewer than **SEVEN** days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without **Architect's**, **Construction Manager's**, or **Owner's** written permission.
3. Comply with NFPA 70E.

B. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **FIVE** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

B. All panelboards shall be rated, listed and labeled for the available short-circuit current by the manufacturer. Minimum interrupting rating of 10,000 amps.

C. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL.

D. Panelboard Short-Circuit Current Rating: Fully Rated to interrupt symmetrical short-circuit current available at terminals.

E. Enclosures:

1. Provide flush and surface enclosures as described on the drawings. Each enclosure shall be rated for environmental conditions at installed location.
2. Provide NEMA 3R enclosures, at a minimum, where panelboards are installed outdoors.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
4. Finishes:
    a. Panels and Trim: Steel with factory enamel finish.
    b. Panel Tubs: Galvanized steel.
5. Locking type doors with concealed hinges
6. **Provide BEST Access Systems locking cylinders with removable 7-pin cores.**
7. Panel tubs shall be 20” wide x 5” deep, minimum.
8. Directory card mounted inside panelboard door inside a transparent card holder.
9. **Hinged Front Cover: Entire front trim/cover of panelboard shall be door in door construction with cover/trim hinged to box and with standard door within hinged trim cover. Outer door shall permit full access to the panel interior without removal of the cover from the panel box. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed. Trims shall cover all live parts and shall have no exposed hardware when both doors are closed.**

F. Phase, Neutral, and Ground Buses:

1. Material: **Aluminum**, **Copper**.
2. Neutral bus (where required) shall be supplied separate from ground Bus.
3. **Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.**
4. **Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.**
5. **Split Bus: Vertical buses divided into individual vertical sections.**

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: copper, or CU/AL bi-metallic type.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

4. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
5. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

H. Where used as service equipment, panelboards shall carry a Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to **SEI/ASCE 7**.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified **and the unit will be fully operational after the seismic event**."

B. Surge Protective Devices shall be provided for all Emergency panelboards (as defined by NEC article 700), and where indicated on drawings. Devices shall be Type II, as specified in section 26 43 13 - Surge Protection for Low Voltage Electrical Power Circuits. Device shall be remote mounted above or below panel enclosure, served from a load side overcurrent protective device, coordinate with SPD manufacture for overcurrent protective device size. SPD circuit conductor length shall not exceed 18”.

1. For service equipment provide Type 1, located ahead of the service disconnect.

2.3 DISTRIBUTION PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), I-Line Style or comparable product by one of the following:

1. Eaton
2. GE/ABB
3. Siemens

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

C. Where main overcurrent protective devices are called for, devices shall be solid-state electronic trip type with LSI adjustable settings.

D. Where main overcurrent protective devices are called for, devices shall be thermal magnetic trip type.

E. Branch overcurrent protective devices shall be molded case type circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

G. Contactors in Main Bus: NEMA ICS 2, Class A, **electrically, mechanically** held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: **120-V branch circuit**, **24-V control circuit**.

2.4 FUSIBLE DISTRIBUTION PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), QMB Style or comparable product by one of the following:

1. Eaton
2. General Electric
3. Siemens

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

C. Overcurrent protective devices shall be fusible switches utilizing Class RK1 fuses. Class J fuses shall not be acceptable.

D. Contactors in Main Bus: NEMA ICS 2, Class A, **electrically, mechanically** held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: **120-V branch circuit, 24-V control circuit**.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), NQ (240V) or NF (480V) Style or comparable product by one of the following:

1. Eaton
2. General Electric
3. Siemens

B. Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

C. Contactors in Main Bus: NEMA ICS 2, Class A, **electrically, mechanically** held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: **120-V branch circuit**, **24-V control circuit**.

D. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

E. Provide AFCI type circuit breakers for circuits serving dwelling units, dormitory units, and hotel/motel guest rooms and suites, in compliance with NEC 210.12.

2.6 LOAD CENTERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), QO Style or comparable product by one of the following:

1. Eaton
2. General Electric
3. Siemens

B. Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

C. Provide AFCI type circuit breakers for circuits serving dwelling units, dormitory units, and hotel/motel guest rooms and suites, in compliance with NEC 210.12.

2.7 ELECTRONIC-GRADE PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), NQ or NF Style or comparable product by one of the following:

1. Eaton
2. General Electric
3. Liebert
4. Siemens

B. Panelboards: With factory-installed, integral Surge Protective Device (SPD); labeled by an NRTL for compliance with UL 67 after installing SPD. Provide Type II device as specified in section 26 43 13, Surge Protection for Low Voltage Electrical Power Circuits.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

E. Buses:

1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
2. Copper equipment and isolated ground buses.

2.8 FUSIBLE PANELBOARDS

A. Manufacturers: Subject to compliance with all stated requirements, provide products by one of the following:

1. Littlefuse LCP Series (Basis of Design)
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.
5. Cooper/Bussman

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Factory UL listing

D. Mains: Circuit breaker or Lugs as identified on drawings.

E. Buses:

1. Size as indicated on drawings.

2. Copper phase and neutral buses;

3. 200 percent capacity neutral bus and lugs.

F. Branch Overcurrent Protective Devices: Circuit breaker devices in line with class CC or class J finger safe fuse holder devices.
   1. Circuit breakers: Comply with 262823 – Circuit Breakers
   2. Fuses / Fuse holders: Provide only products that utilize permanently mounted dead front finger safe fuse holders that open to permit replacement of cartridge type CC or J fuses. Fuse holders shall be provided with blown fuse indication. Provide fuses for all fuse holders provided in the panel. Fuses shall comply with 262813 – Fuses.
   3. Products that utilize any of the following types of fuses are prohibited from use on this project:
      a. Plug on fuse blocks
      b. Fuse holders or fusing approaches that use other than cylindrical cartridge type class 'CC' or class 'J' fuses.
      c. Products that require replacement of any components other than cylindrical cartridge type class 'CC' or class 'J' fuses after an overcurrent event on a branch circuit.

G. Doors: Provide and secure as identified elsewhere in this section

2.9 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state electronic trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

3.2 INSTALLATION

A. Floor set panelboards shall be installed on concrete bases, 4-inch nominal thickness.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.

B. Wall mounted panelboards shall be installed so that the top of the cabinet is 6'-0" above the floor, coordinate panelboard location to avoid interference with other equipment.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box. Assure door swing does not interfere with other equipment.

F. Install filler plates in unused spaces.

G. Where panelboards are to be recessed, stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

I. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: **Owner will engage**, **Engage** a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

C. Panelboards will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

A. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

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SECTION 26 27 13

ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes equipment for:
   1. Electricity metering by utility company
   2. Electricity metering non-utility.

1.2 DEFINITIONS

A. PC: Personal computer.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

   1. Application and operating software documentation.
   2. Software licenses.
   3. Software service agreement.
   4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

   1. Notify **Architect**, **Construction Manage**r, **Owner** no fewer than **SEVEN** days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without **Architect's**, **Construction Manager's**, **Owner's** written permission.

1.6 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

   1. Comply with requirements of utilities providing electrical power services.

2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Meters will be furnished by utility company.

B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

C. Meter Sockets: Comply with requirements of electrical-power utility company.

D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

E. Modular Meter Center: Factory-coordinated assembly of a main service **terminal box with lugs only, disconnect device**, wireways, tenant meter socket modules, and tenant feeder circuit breakers arranged in adjacent vertical sections. Assembly shall be complete with interconnecting buses and other features as specified below.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the drawings, this shall be considered the Basis-of-Design product.

    a. Eaton
    b. General Electric
    c. Siemens
    d. Schneider Electric (Square D)

2. Comply with requirements of utility company for meter center.
3. Housing: NEMA 250, **Type 3R** enclosure.
4. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers.
5. Main Disconnect Device: Fusible switch, series-combination rated by circuit-breaker manufacturer to protect downstream feeder and branch circuit breakers.
6. Tenant Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect circuit breakers in downstream tenant and to house load centers and panelboards that have 10,000-A interrupting capacity.

    a. Identification: Complying with requirements in Section 26 05 53 "Identification for Electrical Systems" with legend identifying tenant's address.
    b. Physical Protection: Tamper resistant, with hasp for padlock.

7. Meter Socket: Rating coordinated with indicated tenant feeder circuit rating.
8. Surge Protection: For main disconnect device, comply with requirements in Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits."

2.2 EQUIPMENT FOR ELECTRICITY METERING NON-UTILITY

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D) or comparable product by one of the following:

1. E-Mon; a division of Hunt Power.
2. Eaton
3. General Electric

4. National Meter Industries.
5. Osaki Meter Sales, Inc.
6. Siemens

B. Meter for Switchboard Use: Revenue grade meter suitable for flush mounted installation in door of NEMA 1 switchboard enclosure. Provide Schneider Electric # Power Logic PM8240 which includes the following features:
   1. Metered/Displayed Values: Voltage, Current, Frequency, Power factor (total and per phase), Apparent power (total, and per phase), Active and reactive power (total and per phase).
   2. Max/Min recording.
   3. Power Quality: Waveform Capture, Harmonic Distortion, Voltage Sag/Swell.
   4. Display Type: TFT LCD
   5. Accuracy: 0.2%, Class 0.2 by ANSI C12.20 and IEC 61557-12.
   6. Onboard Memory: 512 MB of time-stamped data recording.
   7. Web Services: Meter shall be capable of displaying data on web pages, alarm notification by email, and communication over ethernet, Modbus, TCP/IP

C. Meter for Switchboard/Panelboard Use: Non-Revenue grade meter suitable for flush mounted installation in door of NEMA 1 switchboard/panelboard enclosure. Provide Schneider Electric # Power Logic PM5500 which includes the following features:
   1. Metered/Displayed Values: Voltage, Current, Frequency, Energy, Power factor, Active and reactive power.
   2. Max/Min recording.
   3. Display Type: Backlit LCD
   4. Accuracy: 0.5%, Class 0.5 by IEC 62053-22.
   5. Onboard Memory: 256 KB of time-stamped data recording.
   6. Communication: Meter shall be capable of communicating over ethernet, Modbus, TCP/IP.

D. Meter for Panelboard Branch Circuit Use: Multi-circuit 120/277V single and double pole meter harnesses with remote wall mounted control and display cabniet. Provide Schneider Electric # Power Logic EM4900 which includes the following features:
   1. Metered/Displayed Values: Voltage, Current, Energy, Active and reactive power, Pulse Count.
   2. Display Type: Backlit LCD
   3. Accuracy: 0.5%
   4. Analog Input Type: Up to 24 Solid Core CT's.
   5. Communication: Meter shall be capable of communicating over ethernet, Modbus, BACnet, TCP/IP, HTTP.

E. All electric meters shall comply with UL 1244.

2.3 SOFTWARE

A. Software: PC based, a product of meter manufacturer, suitable for calculation of utility cost allocation **and billing**.

   1. Utility Cost Allocation: Automatically import energy-usage records to allocate energy costs per tenant, building, or department. Coordinate requirements with Owner.

   2. Tenant or Activity Billing Software: Automatically import energy-usage records to automatically compute and prepare **tenant bills**, **activity demand and energy-use statements** based on metering of energy use **and peak demand**. Maintain separate directory for each tenant's historical billing information. Prepare summary reports in user-defined formats and time intervals.

B. Technical Support: Beginning with Substantial Completion, provide software support for **TWO** years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within **TWO** years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide **30** days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade his computer equipment if necessary.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install modular meter center according to NECA 400 switchboard installation requirements.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Connect a load of known kilowatt rating, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 27 13

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Receptacles, receptacles with integral GFCI
   2. Weather-resistant receptacles.
   3. Snap switches.
   4. Device cover plates.

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. UTP: Unshielded twisted pair.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

   1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.4 ACTION SUBMITTALS

A. Product data: For each type of device and component indicated. Include manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain all wiring devices and associated wall plates from single source from single manufacturer.

   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper
      b. Hubbell
      c. Legrand

d. Leviton
e. Lutron
f. Pass & Seymour

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices shall be side-wired. Devices that use modular plug-in connectors are not acceptable.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 120 volt, 20 amp: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

B. All convenience and power receptacles shall be Heavy Duty **Specification grade**, **Hospital Grade** grounding type.

1. Where installed within dwelling units, and where connected to 15A circuits, 15A Residential grade receptacles may be utilized.

C. Weather resistant Receptacle shall be ultra-violet, corrosion, and impact resistant, with UL approved “WR” marking on face.

D. Tamper Resistant Receptacles: All 120V and 250V, 15A and 20A, non-locking type receptacles installed in the following locations shall be listed Tamper Resistant, in compliance with NEC 406.12:

1. Dwelling units
2. Guest rooms and guest suites of hotels and motels
3. Child care facilities
4. Preschool and Elementary education facilities
5. Business offices, corridors, waiting rooms in clinics, medical and dental offices and outpatient facilities.
6. Assembly occupancies including gymnasiums, skating rinks, auditoriums, and places of waiting transportation.
7. Dormitories

E. Specialty receptacles shall be as specified on Drawings.

F. Plug-Load Control Receptacles: Receptacles shall be permanently marked to visually differentiate them from uncontrolled receptacles.

G. USB Charging Receptacles: Receptacle shall consist of a tamper-resistant duplex convenience receptacle with one USB-A and one USB-C charge port integral in the face of the receptacle. Device shall supply no less than 24W of charging power.

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type, unless specified otherwise on Drawings.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, and FS W-C-596.

3. Comply with UL 943, device shall be self-testing and provide visual or audible alarm upon ground fault condition.
4. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Weather resistant Receptacle shall be ultra-violet, corrosion, and impact resistant, with UL approved “WR” marking on face.

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 volt, 20 amp:

C. Pilot-Light Switches, 20 amp:

1. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 volt, 20 amp:

1. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 volt, 20 amp; for use with mechanically held lighting contactors.

F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 volt, 20 amp; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.6 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces:
   a. Steel with white baked enamel, suitable for field painting
   b. 0.035-inch- thick, satin-finished, Type 302 stainless steel
   c. 0.04-inch- thick, brushed brass with factory polymer finish
   d. 0.05-inch**-** thick, anodized aluminum
   e. High impact smooth nylon in **Ivory, White, Gray** finish.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.7 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect/Engineer unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including final painting, is complete.

C. Conductors:
1. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
2. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
3. Existing Conductors:
    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Do not remove surface protection, such as plastic film and smudge covers, until immediately prior to occupancy.
3. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
4. Tighten unused terminal screws on the device.
5. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Devices shall be installed vertically with ground pin up, where explicitly shown to be mounted horizontally, position the ground pin to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening. The use of caulk around device plates to seal gaps shall not be permitted.

G. Adjust mounting height and location of Devices: Where devices are installed to serve furniture or furnishings, or otherwise located in the vicinity of furniture or furnishings, the mounting height and location of such Devices shall be adjusted to permit full access to the Devices without the need to move furniture or furnishings. Provide proposed modifications of mounting height and locations for each Device to be changed to Engineer for approval prior to rough-in of said Device.

H. Plug-load controlled receptacles shall be controlled on/off using a time-of-day schedule or local occupancy sensor. Refer to plans for specific control requirements.

3.2 WEATHER RESISTANT RECEPTACLES

A. All 120 volt, 15 amp and 20 amp receptacles installed in damp or wet locations shall be UL listed as weather-resistant and have “WR” mark on face of receptacle. Receptacles installed outside shall be provided with a weather-proof “in-use” cover.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value over 5 percent is unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device shall be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 27 26

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SECTION 26 27 43

ELECTRIC-VEHICLE SERVICE EQUIPMENT - AC LEVEL 1 AND LEVEL 2

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes EVSE that provides AC Level 2 EV charging.

1.3 DEFINITIONS

A. EV: Electric vehicle.

B. EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.

C. EV Charger or EV Charging Equipment: See "EVSE."

D. EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.

E. EV Coupler: A mating EV inlet and connector set.

F. EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.

G. EVSE: Electric-Vehicle Supply Equipment. It includes the EV charging equipment and conductors, including the ungrounded, grounded, and equipment grounding conductors and EV cables, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for transferring energy between the premise wiring and the EV.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for EV charging equipment.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For EVSE.

1. Include plans, elevations, sections, and mounting details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of EVSE that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers are subject to compliance with the requirements on the plans and as specified herein.

B. Level 2 Charging Station:
1. Charge Point
2. Hubbell
3. Legrand
4. Square D (Schneider Electric)
5. Leviton
6. Blink

2.2 REQUIREMENTS

A. Ambient Temperature: 5 to 104 deg F.

B. Relative Humidity: Zero to 95 percent.

C. Surge Withstand: 6 kV at 3000 A.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

E. EV Charging Levels:
1. Single vehicle, AC Level 2 at up to 19.2 kW per vehicle.

2.3 EVSE DESCRIPTION

A. Comply with NFPA 70.

B. Comply with:

1. UL 2231-1.

2. UL 2594.
3. SAE J1772 for SAE combo chargers.

C. Comply with ADA-ABA Accessibility Guidelines.

D. Metering: Revenue grade meter.

E. Control Power: 110/120-V ac, 60 Hz, single phase per charger. Control power shall be derived from integral transformer.

F. Input Power: 40 A, 208/240-V ac, 60 Hz, single-phase services per charger.

G. Integral GFCI.

H. Auto-GFCI fault retry.

I. EVSE Mounting: Bollard mount.

J. Enclosures:

1. Rated for environmental conditions at installed location.
   a. Outdoor Locations: Type 3R.
   b. Lockable.
   c. Tamper resistant.

K. EV Cable and Connectors:

1. SAE J1772 connector.
2. Single connectors[with locking holster].
3. 18-foot cable with cable management system].
4. Field-replaceable connector and cable assembly.

L. Status Indicators:

1. LEDs to indicate power, charging, charging complete, system status, faults, and service.

M. Display Screen:

1. Daylight viewable, UV-protected display with human-machine interface capability.
2. Displays power, charging, charging complete, remote control, system status, faults, and service.

N. Networking:
1. LAN Communications: 802.11b/g/n
2. Capable of remote configuration and reporting.

O. Payment System:

1. RFID reader.
2. PCI compliant.
3. Capable of remote control and authorization.

2.4 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by utilizing cushioning materials or foam or by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1 and NECA 413.

B. Concrete Base Mounting:

1. Install EVSE on 12-inch nominal-diameter and 48-inch- deep concrete base. Comply with requirements for concrete base.

    a. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Install anchor bolts to elevations required for proper attachment to supported equipment.
    c. Secure EVSE to concrete base according to manufacturer's written instructions.

C. Cybersecurity:

1. Software:

    a. Coordinate security requirements with University OCIO.
    b. Ensure that latest stable software release is installed and properly operating.
    c. Disable or change default passwords to password of at least eight characters in length, using a combination of uppercase and lower letters, numbers, and symbols. Record passwords and turn over to party responsible for system operation and administration.

3.2 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

END OF SECTION 26 27 43

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in the following:
   a. Motor-control centers.
   b. Panelboards (fusible).
   c. Switchboards.
   d. Enclosed switches and controllers.
2. Spare-fuse cabinets.

1.2 CLOSEOUT SUBMITTALS

1. Spare Parts Inventory List

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

PART 2 - PRODUCTS

2.1 FUSES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Cooper Bussman or comparable product by one of the following:
1. Cartridge Fuses
   a. Mersen
   b. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: Fuses shall be current-limiting with 200,000 Amps interrupting rating and carry a UL label.
1. Type CC: 600-V, zero- to 30-A rating, 200 kAIC**,** fast acting; 600V – LP-CC
2. Type J: 600-V, zero- to 600-A rating, 200 kAIC; 600V – JDL.
3. Type RK1: Thru 600A, 200 kAIC, dual element, time delay; 250V – LPN-RK, 600V – LPS-RK.
4. Type L: Fuses larger than 600A: Class L, dual element, time delay; 600V – KRP-C.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with **15** percent spare capacity minimum. Provide multiple cabinets if required to meet storage and spare capacity minimums.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- high red letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.
5. Keys: Provide (2) two keys for each cabinet provided. Multiple cabinets if provided shall be keyed alike.

2.4 SPARE PARTS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to **10** percent of the quantity installed for each size and type, but no fewer than **two** of each size and type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Within each fusible device, install fuses that are of the same class and rating. Do not mix class or amperage ratings between multiple fuse positions.

C. Install spare-fuse cabinet(s). Provide wood blocking secured to studs if mounted on a stud wall.

3.2 IDENTIFICATION

A. Install labels complying with requirements for identification specified elsewhere and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Disconnect switches.
2. Molded-case circuit breakers (MCCBs).
3. Molded-case switches.
4. Shunt trip switches.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7** <**Insert requirement**>.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified **and the unit will be fully operational after the seismic event**."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. **Submit on translucent log-log graph paper.**

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

C. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. **Submit on translucent log-log graph paper.**

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to **10** <**Insert number**> percent of quantity installed for each size and type, but no fewer than **three** <**Insert number**> of each size and type.
2. Fuse Pullers: **Two** <**Insert number**> for each size and type.
3. <**Insert extra materials**>.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify **Architect Construction Manager Owner** no fewer than **seven** <**Insert number**> days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without **Architect's Construction Manager's Owner's** written permission.
4. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Eaton
2. GE/ABB
3. Siemens
4. Schneider Electric (Square D).

B. Type HD, heavy duty, fusible and non-fusible, disconnect switches. Switches shall be horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.
7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac, unless noted otherwise.

2.2 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight **green** ON pilot light.
3. Isolated neutral lug;
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; suitable for 120-V ac or 24-V dc coil voltage.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), or comparable product by one of the following:

1. Eaton
2. General Electric
3. Siemens

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes larger than 100 A.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

I. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: **Mechanical** type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: **Circuit-breaker-mounted**, **Universal-mounted**, **Integral**, **Din-rail-mounted** communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage and Phase Loss Detection Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO NC contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: Integrally mounted; 120-V ac, unless noted otherwise.

2.4 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following manufacturers**:

1. Eaton
2. General Electric
3. Siemens
4. Schneider Electric (Square D).

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
6. Alarm Switch: One NO NC contact that operates only when switch has tripped.
7. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
8. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
9. Electrical Operator: Provide remote control for on, off, and reset operations.
10. Accessory Control Power Voltage: Integrally mounted, 120-V ac, unless noted otherwise.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, **Type 7, Type 9** .

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: **Owner will engage, Engage** a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges **as specified in Section 260573 "Overcurrent Protective Device Coordination Study."**

END OF SECTION 26 28 16

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SECTION 26 28 17

ELEVATOR SAFETY SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide the labor, tools, equipment, and material necessary to install safety switches in accordance with the plans and as specified herein.

1.2 QUALITY ASSURANCE

A. All work shall be performed in accordance with the latest edition of applicable standards, codes and laws.
   1. NFPA 70 – Current Edition; Article 620.
   2. ANSI/ASME A17.1 – Current Edition.
   3. BOCA 3006.2.3
   4. NFPA 72 – Current Edition.

B. Except as modified by governing codes, all equipment shall be manufactured in accordance with the latest applicable standard
   1. U.L. 98 and CSA – C22.2 No. 4

PART 2 - PRODUCTS

2.1 MATERIALS

A. Elevator Control Switch in a single NEMA 1 enclosure with all necessary relay(s), control transformer and other options (as listed below), and as shown on drawings. The Elevator Control Switch shall be constructed, listed, and certified to the standards as listed in above. The Elevator Control Switch shall include the following features:
   1. Horsepower rated fusible switch with shunt trip capabilities. The ampere rating of the switch shall be based upon elevator manufacturer requirements and use Class J Fuses.
   2. Include as an accessory, a 100 VA control power transformer with primary and secondary fuses. The primary voltage rating shall match the incoming circuit voltage with a 120-volt secondary.
   3. Contain isolation relay (3PDT, 10 amp, 120V). The coil of the isolation relay shall be 120 Vac. A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid.
   4. Include a 120-volt key to test switch.
   5. Provide mechanically interlocked auxiliary contacts (1 N.O./1 N.C). rated 5A, 120 Vac as standard.
   6. The switch shall contain the following options:
      a. “ON” Pilot Light (Green)
      b. Isolated Full Capacity Neutral Lug
      c. Fire Alarm Voltage Monitoring Relay

B. Refer to Section “Fuses” for additional fuse requirements.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the drawings, this shall be considered the Basis-of-Design product.
   1. Cooper Bussmann
   2. Eaton Corp.
   3. Littelfuse
   4. Mersen

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install safety switches as indicated, complying with manufacturer's written instructions.

B. Install safety switches for use with elevator equipment, motors and controllers within sight of the motor position unless otherwise indicated.

C. Provide suitable means for mounting safety switches.

D. Use flexible conduit to and from safety switches where vibration isolation is required.

E. Provide fuses sized in accordance with equipment manufacturer’s data plate.

F. Fuses shall not be installed until equipment is ready to be energized

G. Touch-up all scratches after installation.

END OF SECTION 26 28 17

SECTION 26 29 13

ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:

1. Full-voltage manual motor starters
2. Full-voltage magnetic motor starters

1.2 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7**.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified **and the unit will be fully operational after the seismic event**."

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.5 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses for Fused Switches: Equal to [10] percent of quantity installed for each size and type, but no fewer than [three] of each size and type.
2. Control Power Fuses: Equal to [10] percent of quantity installed for each size and type, but no fewer than [two] of each size and type.
3. Indicating Lights: [Two] of each type and color installed.
4. Auxiliary Contacts: Furnish [one] spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish [three] spares for each size and type of magnetic contactor installed.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), or comparable product by one of the following:

1. Eaton
2. GE/ABB
3. Siemens

2.2 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Configuration: Nonreversing.

2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2; heaters matched to nameplate full-load current of actual protected motor; external reset push button**;** melting alloy type.

3. Flush devices where installed in finished spaces, otherwise surface mounting.

4. Red pilot light.

C. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Configuration: Nonreversing.

2. Contactor Coils: Pressure-encapsulated type.

   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

3. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

4. Control Circuits: **120**V ac.

5. Integral CPT, with primary and secondary fuses, of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

6. Melting Alloy Overload Relays:

   a. Inverse-time-current characteristic.
   b. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.

7. Solid-State Overload Relay:

   a. Switch or dial selectable for motor running overload protection.
   b. Sensors in each phase.
   c. Selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

8. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

9. Fusible Disconnecting Means:

   a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate **Class R** fuses.
   b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

10. Nonfusible Disconnecting Means:

    a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

11. Auxiliary Devices: Provide heavy duty pushbuttons, LED pilot lights to indicate motor status, and Hand-Off-Auto (HOA) rotary switch. All devices shall be factory mounted in enclosure cover.

2.3 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Provide NEMA 1 enclosures for indoor dry environments. Where located outdoors, or in wet environments provide NEMA 3R enclosures, unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

3.2 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.3 CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

B. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. **Test and adjust controllers, components, and equipment.**
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages.
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multi-pole enclosed controller 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train, **Train** Owner's maintenance personnel to **adjust, operate, and maintain enclosed controllers.**

END OF SECTION 26 29 13

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SECTION 26 41 13

LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes lightning protection system for the following:

1. Ordinary structures.

1.2 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, coordinated with each other, using input from installers of the items involved:

B. Qualification Data: For Installer.

C. Product certificates.

D. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Completion Certificate:

1. UL Master Label Certificate

1.4 QUALITY ASSURANCE

A. Installer Qualifications: LPI Master Installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning and Grounding.
7. ILSCO.

8. Newton Instument Company.
9. O-Z/Gedney; A Brand of the EGS Electrical Group.
10. Robbins Lightning, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. UL Lightning Protection Standard: Comply with UL 96A requirements for [**Class I (up to 75')**] [**Class II (>75')**] buildings.

B. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

2.3 MATERIALS

A. Air Terminals:

1. **[Copper][Aluminum]** unless otherwise indicated.
2. Minimum 1/2-inch diameter by 12-inch long.
3. Rounded safety tip.
4. Threaded base support.

B. Class 1 Main Conductors:

1. [**Stranded Copper: 57,400 circular mils in diameter**].
2. [**Aluminum: 98,600 circular mils in diameter**].

C. Class II Main Conductors:

1. [**Stranded Copper: 115,000 circular mils in diameter**].
2. [**Aluminum: 192,000 circular mils in diameter**].

D. Secondary Conductors:

1. [**Stranded Copper: 26,240 circular mils in diameter**].
2. [**Aluminum: 41,400 circular mils in diameter**].

E. Ground Loop Conductor: Stranded copper**.**

F. Ground Rods:

1. Material: Copper-clad steel.
2. Diameter: 3/4-inch.
3. Rods shall be not less than 120-inches long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A.

B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.

C. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for concealed installations in UL 96A.

D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

3.2 CONNECTIONS

A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds listed for the purpose.

B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: bolted connectors.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Perform inspections as required to obtain a UL Master Label for system.
2. Perform inspections to obtain an LPI certification.

B. Prepare test and inspection reports and certificates.

END OF SECTION 26 41 13

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SECTION 26 43 13

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes field-mounted Surge Protective Devices (SPDs) for low-voltage (120 to 600 V) power distribution and control equipment.

B. Refer to the following specification sections for Surge Protective Devices which are to be factory installed in equipment.
   1. 26 23 00 – Switchgear
   2. 26 24 13 – Switchboards
   3. 26 24 16 – Panelboards

1.2 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Five** years from date of Substantial Completion, unless listed otherwise in the following paragraphs.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Where surge protective device is shown attached to an automatic transfer switch or other equipment without integral overcurrent protective devices, provide surge protective device with integral disconnect switch.

D. Provide device in powder coated, impact resistant steel enclosure. Where shown to be installed outdoors, provide weatherproof NEMA 3R enclosure.

2.2 SPD FOR SERVICE EQUIPMENT AND SWITCHBOARDS.

A. Basis-of-Design Product: Subject to compliance with requirements, provide Joslyn by Thomas & Betts (JSP-240) or comparable product by one of the following:

1. Eaton
2. Emerson
3. GE
4. Schneider Electric
5. Siemens

B. Provide UL 1449, Type I devices suitable for the voltage shown on the drawings.

C. Surge capacity of 240,000A per phase, 120,000A per mode, fully rated (SCCR) of 200KAIC, with TEN modes of protection (L-L, L-G, L-N, N-G). Each mode shall be protected with individually fused MOVs. Nominal discharge current (I-n) shall be 20,000A.

1. SPDs with the following features and accessories:
   a. Indicator light display for protection status.
   b. Surge counter.
   c. Transient Filter complying with UL 1283 for electromagnetic interference.
   d. Form-C contacts (1 N.O, 1 N.C.), for remote monitoring of protection status.

2.3 SPD FOR DISTRIBUTION EQUIPMENT

A. Basis-of-Design Product: Subject to compliance with requirements, provide Joslyn by Thomas & Betts (JSP-120) or comparable product by one of the following:

1. Eaton
2. Emerson
3. GE
4. Schneider Electric
5. Siemens

B. Provide UL 1449, Type **2** devices suitable for the voltage shown on the drawings.

C. Surge capacity of 120,000A per phase, 60,000A per mode, fully rated (SCCR) of 100KAIC, with TEN modes of protection (L-L, L-G, L-N, N-G). Each mode shall be protected with individually fused MOVs. Nominal discharge current (I-n) shall be 20,000A.

1. SPDs with the following features and accessories:
   a. Indicator light display for protection status.
   b. Surge counter.
   c. Transient Filter complying with UL 1283 for electromagnetic interference.
   d. Form-C contacts (1 N.O, 1 N.C.), for remote monitoring of protection status, where indicted on drawings.

2.4 SPD FOR PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Joslyn by Thomas & Betts (TransEnd 50) or comparable product by one of the following:

1. Eaton
2. Emerson
3. GE
4. Schneider Electric
5. Siemens

B. Provide UL 1449, Type 2 devices suitable for the voltage shown on the drawings.

C. Surge capacity of 100,000A per phase, 50,000A per mode, fully rated (SCCR) of 65KAIC, with TEN modes of protection (L-L, L-G, L-N, N-G). Each mode shall be protected with individually fused MOVs. Nominal discharge current (I-n) shall be 20,000A.

1. SPDs with the following features and accessories:
   a. Indicator light display for protection status.
   b. Metallic flexible conduit whip.
   c. Transient Filter complying with UL 1283 for electromagnetic interference.
   d. Form-C contacts (1 N.O, 1 N.C.), for remote monitoring of protection status, where indicated on drawings.

2.5 SPD FOR SINGLE-PHASE LOADS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Joslyn by Thomas & Betts (Surgitron III) or comparable product by one of the following:

1. Eaton
2. Emerson
3. GE

4. Schneider Electric
5. Siemens

B. Provide UL 1449, Type 2 devices suitable for the voltage shown on the drawings.

C. Surge capacity of 40,000A per phase, fully rated (SCCR) of 50 KAIC, with all modes of protection. Each mode shall be protected with individually fused MOVs.

1. SPDs with the following features and accessories:
   a. Indicator light display for protection status.
   b. Metallic flexible conduit whip.
   c. Three year warranty.

2.6 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 22 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.
   1. Final test and inspection reports shall document the quantity of surges recorded on all SPD surge counters at the completion of the testing, and the date that the observation was made.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 26 43 13

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SECTION 26 51 19

LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for LED luminaires indicated in the Luminaire Schedule on the drawings.

B. Luminaire supports.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests IES LM-79 and IES LM-80.
    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
7. LED driver or power supply product data sheets for each luminaire.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.
4. Where specifically indicated on plans, include photometric PxP drawings for areas where alternate fixtures are supplied.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of luminaire.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. One (1) copy of each approved submittal.

2. Certificate of Material Receipt.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Drivers: TEN percent of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: ONE percent of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: ONE percent of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Provide luminaires from a single manufacturer for each luminaire type.

B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

C. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: FIVE year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

A. Provide Luminaires as scheduled on the Drawings.

B. Provide luminaires with integral thermal protection.

C. LED luminaire shall be modular in design with the ability to replace individual components (LED Modules, drivers, etc.) without having to replace the entire luminaire.

D. All LED luminaire shall have a minimum CRI of 80.

E. Unless specifically indicated otherwise per the luminaire schedule, all LED lamp CCT shall be 4000K.

F. LED/LED Module and driver shall be rated for a minimum of 50,000 hours of life at 80% output (LM-80).

G. For each type Luminaire, the LED/LED Module shall originate from a common manufactured batch source.

H. All LED/LED Module shall adhere to LED package manufacturer guidelines, certification programs, and test procedures for thermal management.

I. Driver shall be FCC Part 15 compliant, UL 8750.

J. Driver shall meet ANSI C62.41 category A surge protection standards up to 4kV.

K. All LED drivers shall have a power factor greater than 0.90.

L. Emergency LED battery pack shall be integral mounted, ninety (90) minute capacity, sealed maintenance free nickel cadmium battery and integral charger, operate at rated lumen output of fixture or next highest lumen output available providing no less than 50% of the standard lumen output, and have remote mountable charging indicator light and test switch. LED drivers shall feature a self-diagnostic circuit that automatically tests unit and reports failure with an audible and visual alarm.

M. Ambient Temperature: Indoor Luminaires, 41 to 104 deg F.; Outdoor Luminaires, 5 to 104 deg F.

1. Relative Humidity: Zero to 95 percent.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

F. California Title 24 compliant.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch minimum diameter steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 14 AWG. Min.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Regardless of locations shown or mounting heights indicated on drawings, do not rough or install luminaires in locations where they conflict with existing or new equipment. Luminaires that are installed in locations or heights that conflict with the work of other trades, or conflict with the operation or maintenance requirements of equipment shown in the construction drawings shall be relocated as required to resolve such conflicts at the contractor's expense.

D. Install lamps in each luminaire.

E. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

G. Wall-Mounted Luminaires:

1. Where recommended by luminaire manufacturer, attach to structural members in walls. Otherwise mount fixture to back box.
2. Do not attach luminaires directly to gypsum board.

H. Suspended Luminaires:

1. Ceiling Mount:
   a. Provide quantity of stems or adjustable aircraft cable to support suspended fixtures as described in the luminaire schedule and manufactures installation instructions.

2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Continuous Rows of Luminaires: Use stems, rod, or aircraft cable support as indicated in luminaire schedule, for suspension of each unit length of luminaire chassis, including one at each end. Maximum span shall not exceed 12'.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
6. Use of strut or other means to group mount luminaires are prohibited in space types as noted below. Luminaires in these locations noted below shall be individually mounted unless specifically noted on drawings to be group mounted:
   a. Electrical rooms
   b. Mechanical rooms
   c. [other space types where ductwork or equipment may be installed without ceilings]

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid in a minimum of four locations, spaced near corners of luminaire.
4. Do not use ceiling grid as support for luminaires. Support with aircraft cable or similar wire from building structure from a minimum of TWO locations, independent of the ceiling system.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."

B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.7 ADJUSTING

A. Adjustments after installation: Prior to project completion but after all luminaires have been completely installed, meet on site with the A/E to review the installation and setup of all lighting fixtures supplied on the project. Review each unique fixture type and condition installed on the project. Make proper adjustments to each luminaire as required for function and operation as intended by the A/E. Such work shall include but not be limited to:
   1. Making minor adjustments to the heights of cable suspended luminaires as required for plumbness, coordination of installation heights with field conditions, or to address discomfort glare from illumination sources.
   2. Opening each luminaire and adjusting trim potentiometers, dip switches, or other adjustable elements that may control the output level, color temperature, network address, or other configurable parameters.
   3. Adjust aiming angles of luminaires as required for operation as intended by the A/E.

B. Occupancy Adjustments: When requested within TWELVE months of date of Substantial Completion, provide on-site assistance in adjusting luminaires to suit occupied conditions. Make up to [**TWO**] visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

   1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Open luminaires as requested and adjust trim potentiometers, dip switches, or other adjustable elements that may control the output level, color temperature, network address, or other configurable parameters.
   4. Adjust the aim of luminaires in the presence of the Architect.

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SECTION 26 52 13

EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.
4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Product Schedule:

1. For all luminaires and exit signs, use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Provide seismic qualification certificate for each piece of equipment.

B. Product Test Reports: For each luminaire for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: TEN percent of each type and rating installed. Furnish at least one of each type.
2. Luminaire-mounted, emergency battery pack: FIVE percent emergency lighting units. Furnish at least one of each type.
3. Diffusers and Lenses: ONE percent of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: ONE percent of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

C. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires and signs in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: TWO year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Power Unit Batteries: FIVE years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.
2. Warranty Period for Self-Powered Exit Sign Batteries: FIVE years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.

1. Emergency Connection: Operate one lamp or an equivalent number of LED’s continuously at an output of no less than 50% of total lumen output upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Ambient Temperature: Indoor Luminaires, 41 to 104 deg F.; Outdoor Luminaires, 5 to 104 deg F..
   b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
   c. Humidity: More than 95 percent (condensing).
4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.

   a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

5. Battery: Sealed, maintenance-free, nickel-cadmium type.
6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

F. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.

1. Emergency Connection: Operate one lamp or an equivalent number of LED's continuously at an output of no less than 50% of total lumen output upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Battery: Sealed, maintenance-free, nickel-cadmium type.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.
6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
8. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.3 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

B. Emergency Luminaires:
1. Emergency Luminaires: Drawing designation as indicated in the Luminaire Schedule on Drawings, with the following additional features:
a. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations. Indoor and outdoor applications as shown on plans.
b. UL 94 flame rating.

C. Emergency Lighting Unit:
1. Emergency Lighting Unit: as indicated in the Luminaire Schedule on Drawings.
2. Operating at nominal voltage matching lighting system.
3. Wall, ceiling, or stem mounted with universal junction box adaptor.
4. UV stable thermoplastic housing.
5. Two LED lamp heads.
6. Internal emergency power unit.

D. Remote Emergency Lighting Units:
1. Emergency Lighting Unit: as indicated on Drawings.
2. Operating at nominal voltage matching lighting system.

3. Wall, ceiling, or stem mounted with universal junction box adaptor.
4. UV stable thermoplastic housing, provide wet location listing where shown outdoors.
5. LED lamp heads.
6. External emergency power unit.

2.4 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Operating at nominal voltage as shown on plans.
2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional battery capacity for power connection to remote units where shown.

C. Self-Luminous Signs:
1. Powered by tritium gas, with universal bracket for flush-ceiling, wall, or end mounting. Signs shall be guaranteed by manufacturer to maintain the minimum brightness requirements in UL 924 for 20 years.
2. Use strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Include universal bracket for flush-ceiling, wall, or end mounting.

2.5 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

2.6 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:
1. Where recommended by luminaire manufacturer, attach to structural members in walls. Otherwise mount fixture to back box.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service:

1. Charge [emergency power units] [and] [batteries] minimum of one hour and depress switch to conduct short-duration test.
2. Charge [emergency power units] [and] [batteries] minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

A. Adjustments: Within [12] <Insert number> months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace lamps, [emergency power units] [, batteries,] [signs,] or luminaires that are defective.

a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 26 52 13

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SECTION 26 56 00

LIGHTING SYSTEM

PART 1 -GENERAL

1.1 DESCRIPTION

A. Provide all labor, material, equipment, tools, and services necessary for, and incidental to, the proper installation of all interior and exterior luminaires herein specified and as shown on the Construction Documents. Provide all lamps for all fixtures of size and type as recommended by the fixture manufacturer and as scheduled.

B. Types of fixtures, reflectors, refractors, lenses, louvers, ballasts, and lamps shall be as shown on the Construction Documents in the Luminaire Schedule, and shall be furnished complete with plaster frames, bar hangers, mounting stems, and other accessories necessary for proper installation.

1.2 QUALITY ASSURANCE

A. All luminaires shall conform to the requirements of the National Electrical Code (NEC), NEMA, ANSI, IEEE, IES, CBM, NFPA, and shall be labeled with the Underwriters Laboratories Seal of Inspection.

B. Luminaires shall comply with all requirements of the Regulatory Agencies and shall conform to State Code, Local Codes, and Ordinances.

C. Integrated equipment rating tests shall be factory performed and adjusted for rated continuous current, rated light output, enclosure stability, and dielectric strength.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Materials shall be stored to protect them from damage prior to installation. Material shall not be stored directly on the ground or floor and shall be kept as clean and dry and free from damage or deteriorating elements.

B. Deliver products to project properly identified with names, types, grades, compliance labels and similar information needed for distinct identification. Materials must be adequately packaged or protected to prevent deterioration during shipment, storage and handling.

C. The finished surfaces of all luminaires shall not be defaced in any way and shall be cleaned to original finish at time of completion of the work.

1.4 SUBMITTALS

A. Submittal Schedule
   1. Within thirty (30) days of contract award, the Contractor shall submit a complete list of lighting products he intends on furnishing with manufacturer and catalog designations, along with currently quoted lead times for delivery of same. Should the Contractor anticipate that the delivery schedule of any specified product may adversely impact the construction schedule, he shall bring it to the attention of the Architect or Owner's Representative at this time.

2. Within thirty (30) days of bid award, contractor shall provide a complete list of all lamps which will be furnished on the project. This list shall be organized alphabetically by the luminaire type indicated on the luminaire schedule, and include the manufacturer and exact model number of each lamp.
3. Luminaires shall not be lot priced, provide unit pricing.

B. Shop Drawings: Indicate dimensions and components for each luminaire, not standard product of manufacturer. Provide shop drawings for each type of lamp, ballast and driver specified. Submit cover sheet with a matrix of all luminaire types and catalog numbers submitted.

C. Product Data:
1. Submit physical characteristics of each luminaire showing conduit entrances, physical dimensions, component locations, electrical ratings, mounting hardware, and nameplate nomenclature.
2. Submit manufacturer's written recommendations for storage and protection, installation and instructions, and field test requirements.
3. Submit certified reports of fixture performance in accordance with IESNA accepted standards in IES photometric format covering candlepower distribution curves, luminaire efficiency, coefficients of utilization, and isolux chart (both horizontal and vertical footcandles) for each luminaire.
4. Submit manufacturer's instructions for testing, troubleshooting, performing cleaning, and operating and maintenance.

D. Substitutions
1. The lighting equipment specified herein has been carefully specified for its ability to meet the luminous environment requirements of this project. Calculations have been performed by the design team to determine horizontal and vertical illuminances. Equipment and manufacturers which have been shown to comply with established criteria are specified. Substitutions in all likelihood will be unable to meet all of the same criteria as the specified equipment.
2. Voluntary product substitutions from the Contractor will not be considered.
3. Should the Contractor wish to have products considered other than those specified, they must submit those items ten (10) days in advance of the bid. Non-returnable working samples of the unsolicited substitutions should be included. Failure to submit within that deadline will require that the specified products will be supplied. Submittal of a bid for this project shall include a written acknowledgment of these terms from the Contractor.
4. Bid value shall not be based on substitutions in expectation of approval.

1.5 CLOSEOUT SUBMITTALS

A. Submit an itemized list, including Manufacturer's order numbers, of each type of lamp, light source and power supply to be able to obtain identical replacement lamps.

PART 2 -PRODUCTS

2.1 LUMINAIRES

A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.

B. Provide all sources of a particular type or classification by the same manufacturer to maintain color consistency throughout the project.

C. All LED luminaire manufacturers shall provide electrical and photometric data performed in accordance with IESNA LM-79-08 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

D. LED luminaires shall be designed with heat sinking adequate such that the junction temperature of the LEDs in maintained to meet the rated life as published by the LED manufacturer. Luminaire manufacturer shall provide validation documentation.

E. Manufacturer shall provide photometric performance data on luminaires in accordance with ANSI/IES LM-63-02: ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information.

F. LED luminaires shall have a minimum complete five year warranty from the date of installation unless a ten year warranty is required per the luminaire schedule.

G. Coordinate attic stock of luminaires and drivers with Owner. Assume 5%-10%.

2.2 LUMINAIRE MANUFACTURERS

A. Manufacturers
   1. The Base Bid lighting fixtures shall be from the Manufacturers listed in the Luminaire Schedule on the Drawings. Contractor shall only submit on the products that are specified, or those listed as alternates. Submission of unsolicited substitutions will be treated as Non-Listed Manufacturers.
   2. Manufacturers not listed must be pre-qualified to bid as follows:
   a. Manufacturer shall have not less than five years experience in design and manufacture of lighting fixtures of the type and quality shown. Pre-qualification submissions must include a list of completed projects and dated catalog pages indicating length of experience.
   b. Manufacturer shall also submit a working 120Volt non-returnable sample with cord and plug for review by the Owner's Representative and Lighting Designer.
   3. Single source luminaires are listed based solely on specific performance criteria to that luminaire and require unit pricing on bid day. Single source luminaire shall not be lot priced.

B. Construction
   1. Fixture enclosures shall be fabricated with a minimum of 20 gauge cold rolled steel. Enclosures may be of other materials, provided they are equal in mechanical strength.
   2. Recessed downlight reflectors required to have "haze" Alzak finish and be constructed of one-piece of spun aluminum unless otherwise specified in the Luminaire Schedule. All ceiling trims must fit tight to the luminaire with no light leaks.
   3. No labels or stickers are to be visible through the luminaire.
   4. Adjustable accent luminaires must have locking tilt and locking rotation to ensure focus is not disturbed during re-lamping and maintenance.

2.3 LED LIGHT SOURCES

A. All LED light sources intended for indoor application shall have a correlated color temperature of 4000K (unless specifically noted in the schedule).

B. Published LED life ratings shall be based on the point at which LED sources reach L70 lumen maintenance and tested in tested in accordance with IES LM80-08 Approved Method: Testing Lumen Maintenance of LED light sources.

C. In instances where the LED sources are to be mounted directly into the architecture, the LED manufacturer shall provide a recommended heat sink volume adequate to achieve rated life at L70.

D. All LEDs light sources shall have a CRI >/=90.

E. All LED sources shall have </= to 3 step binning for color consistency and uniformity.

2.4 LED DRIVERS

A. General Requirements:

1. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment.

2. Operate for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.

3. Provide thermal fold-back protection by automatically reducing power output (dimming) to protect LED driver and LED light engine/fixture from damage due to over-temperature conditions that approach or exceed the LED driver's maximum operating temperature at calibration point.

4. Provide integral recording of operating hours and maximum operating temperature to aid in troubleshooting and warranty claims.

5. Designed and tested to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.

6. Manufactured in a facility that employs ESD reduction practices in compliance with ANSI/ESD S20.20.

7. UL 8750 recognized or listed as applicable.

8. UL Type TL rated or UL Class P listed where possible to allow for easier fixture evaluation and listing of different driver series.

9. Suitable for field replacement as applicable; listed in accordance with UL 1598C or UL 8750, Class P as indicated.

10. Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.

11. Class A sound rating; Inaudible in a 27 dBA ambient.

12. Demonstrate no visible change in light output with a variation of plus or minus 10 percent change in line-voltage input.

13. LED drivers of the same family/series to track evenly across multiple fixtures at all light levels.

14. Offer programmable output currents in 10 mA increments within designed driver operating ranges for custom fixture length and lumen output configurations, while meeting a low-end dimming range of 100 to 1 percent or 100 to 5 percent as applicable.

15. Meet NEMA 410 inrush requirements for mitigating inrush currents with solid state lighting sources.

16. Employ integral fault protection up to 277 V to prevent LED driver damage or failure in the event of incorrect application of line-voltage to communication link inputs.

17. LED driver may be remote located up to 100 feet (30 m) from LED light engine depending on power outputs required and wire gauge utilized by installer.

A.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install fixtures, lamps, lenses, etc., after building is enclosed, weathertight, and environmental conditions are nominally the same as expected for the complete spaces. All lamps, glassware, reflectors and refractors shall be clean and free of chips, cracks and scratches. Glassware and lamps shall not be installed until approved by the Owner's Representative. Every luminaire shall have a lighting outlet unless otherwise directed. In instances where a specific type of fixture has not been assigned to an outlet, provide a complete fixture of the type and wattage designated for outlets of similar function and/or type as directed by the Owner's Representative or Engineer.

B. Furnish and install all necessary hangers, supports, framing, fittings, etc., to support fixtures and fixture outlets. All fixture supports shall be securely anchored to the ceiling and/or building construction and shall be capable of supporting the fixture in question plus 100% additional weight. Recessed 2' x 4' and 2' x 2' fixtures shall be independently wire supported at each corner of the fixture from the structural ceiling (not the ceiling grid). This Contractor shall coordinate with the Ceiling Contractor to insure that these supports are installed. Fluorescent fixtures utilizing single ended compact fluorescent lamps shall be installed so all fixtures within a room or area are oriented in the same direction.

C. For recessed (flush) mounted fixtures, the Contractor shall coordinate the installation and construction details with ceiling system in which they are installed, i.e. support system dimensions, flanges (where required), acoustical tile, or pan pattern, etc. The Contractor shall verify the specific ceiling construction is appropriate for the fixture specified before ordering the luminaires. This Contractor shall coordinate his work with that of structural, masonry, patching, plastering and acoustical tile Contractors to assure proper locations of openings for all fixtures. Ceiling outlets in acoustical tile ceilings shall be spaced and installed so as to replace the ceiling tile in accordance with the acoustical ceiling layouts.

D. Flush type fixtures shall be securely fastened to the ceiling framework, and supplied with finished metal trim for plastered or acoustical ceiling. In general, the Manufacturer and catalog number of

the fixture type is given in the Luminaire Schedule; however, this Contractor shall verify the ceiling suspension system to be installed and shall provide the proper type fixture suspension straps, retaining clips, supporting hooks, etc., as required to properly support the fixture. Flange type, snap-in or lay-in fixture trims shall be furnished, as required, for the ceiling system installed.

E. All suspended fixtures shall be constructed with swivel device such that canopies will neatly fit slope of ceilings and fixtures hang plumb. Flexible conduit or cord connections will not be approved for feeding suspended fixtures, unless specifically indicated in the Luminaire Schedule.

F. Flush fixtures shall have the branch circuit system terminated in a junction box above the ceiling, but accessible through ceiling opening. Four feet (4') of 1/2" flexible metal conduit shall be provided between the junction box and the fixture housing.

G. All exposed fixture housings shall be so installed that the housing surface, trim frame, door frame, and lens frame shall be free of light leaks. The lens door shall close in a light-tight manner.

H. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, and latches shall function easily by finger action without the use of tools.

I. Only the number of lamps required to provide adequate temporary lighting for construction work to be completed shall be installed by this Contractor at the time luminaires are installed and tested. The remaining lamps shall be installed within 30 days of final inspection of the project. All lamps shall be in working order at the time of final acceptance of the work by the Owner's Representative and the Owner. This Contractor shall replace all defective lamps with new lamps until the work is finally accepted. All lamps shall be guaranteed for their published rated operating life.

J. Recessed incandescent luminaires for installation in ceiling construction, where fixtures will be in direct contact with thermal insulation, shall be equipped with internal thermal protection and shall be so identified. Recessed incandescent luminaires installed flush in suspended grid ceilings, where fixtures will not be in direct contact with thermal insulation, shall be standard fixture so identified for this particular type of installation.

K. Exterior wall mounted fixtures shall have the joint between the fixture and wall on top and both sides sealed with a silicon sealer. Do not seal the joint at the bottom to allow for drainage.

L. Upon completion of installation of interior luminaires, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

M. At date of substantial completion, replace lamps in interior luminaires which are observed to be noticeably dimmed after Contractor's use and testing, as judged by the Owner's Representative/Engineer. Furnish stock of replacement lamps amounting to 5 percent (but not less than one lamp in each case) of each type and size lamp used in each type fixture. Deliver replacement stock as directed to Owner's storage space.

3.2 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTABLE LUMINAIRES

A. Aim and adjust luminaires as directed by the Lighting Designer, Owner's Representative, or Electrical Engineer. Exterior adjustable luminaires shall be aimed at night.

3.4 CLEANING

A. Fixtures shall be mounted straight, level and true to the building lines. Warped or damaged fixtures shall be replaced or repaired to the satisfaction of the Owner's Representative and Owner.

B. Immediately preceding the final inspection, this Contractor shall thoroughly clean all fixtures of dust, dirt, grease, fingermarks, etc. All lamps shall be operating at the time of Owner's acceptance.

3.5 PROTECTION OF FINISHED WORK

A. Relamp luminaires having failed lamps at Substantial Completion.

END OF SECTION

Project		**Catalog #**		**Type**	
Prepared by		**Notes**		**Date**	

Downlight

Wall Wash

Portfolio

LD4C | EU4C | 4LB

4" Round, New Construction Downlight
Narrow, Medium, Wide Beam or Wall Wash
250-7500 Lumens

Typical Applications

Office • Education • Healthcare • Hospitality • Retail • Code-Compliance Areas • Sports Venues

Interactive Menu

- Order Information page 2
- Product Specifications page 4
- Energy Data page 6
- Photometric Data page 7
- Connected System page 14
- Product Warranty

Product Certification

ENERGY STAR · Efficiency Standards T24 · RoHS COMPLIANT · UL CERTIFIED · wet location · 2022 PROGRESS Report SELECTION

Control Compatibility

WaveLinx LITE · WaveLinx PRO

Product Features

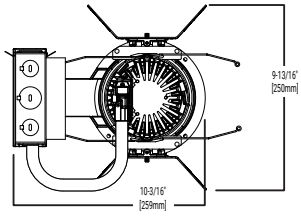
powered by fifthlight technology · Showerlight · PLENUM RESPONSE CERTIFIED · BAA BUY AMERICAN ACT AVAILABLE · TAA TRADE AGREEMENTS ACT AVAILABLE

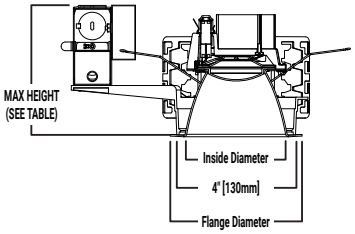
Top Product Features

- 250-7500 lumens; Offered in 90 and 97 CRI; ENERGY STAR® qualified
- Easy disconnect for LED engine replacement and installation
- Optional snap in driver for ease of replacement
- Standard 0-10V driver dims to 1%
- 2400K, 2700K, 3000K, 3500K, 4000K, 5000K; D2W™ option from 3000K to 1850K
- Available W2N tunable white CCT range 2700K to 6500K or 2000K to 5000K
- Options to meet Buy American and other domestic preference requirements

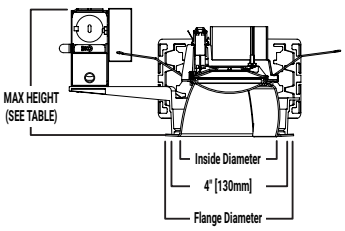
Dimensional and Mounting Details

DOWNLIGHT





WALL WASH



DT4RF=4 inch frosted acrylic ring
See Accessories for Ordering

CLICK HERE dimension information

Single Line Order Information

Multi-line Ordering Information Option

SAMPLE ORDER NUMBER: **LD4C109030D010M1H**

Invoice will indicate separate fixture components (housing, trim, module) which will ship complete from a single CLS facility in separate cartons.
To receive separate components (housing, trim, module) shipment, click on the "Multi-Line Ordering Information Option" button to the right.

Housing	Lumen [1]				Color Control	CCT [20]	
LD4C=LED Downlight 4" Nominal Aperture **LD4CCP**=LED Downlight 4" Nominal Aperture, Chicago Plenum For BAA or TAA use Multi-line Ordering	**02** = 250 lumens, IC rated **05** = 500 lumens, IC rated **08** = 800 lumens, IC rated **10** = 1000 Lumens **10IC** = 1000 Lumens, IC rated	**15** = 1500 Lumens **15IC** = 1500 Lumens, IC rated **20** = 2000 Lumens **25** = 2500 lumens **30** = 3000 Lumens	**35** = 3500 lumens **40** = 4000 Lumens **45** = 4500 Lumens [10] **50** = 5000 Lumens [10] **55** = 5500 Lumens [10]	**60** = 6000 Lumens [10] **65** = 6500 Lumens [10] **70** = 7000 Lumens [10] **75** = 7500 Lumens [10]	**90**=90 CRI Minimum **97**=97 CRI Minimum	**90 CRI** **24**=2400K **27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K	**97 CRI** **27**=2700K **30**=3000K

Specify from Driver column. Information below for reference only.

Driver	Remote driver & plug in driver
D010=0-10V Dimming, 1% to 100%, 120V-277V up to 7000 lumens (up to 3000 lumens for remote driver) **1D010**=0-10V Dimming, 1% to 100%, 120V 7500 lumens (3500 to 7000 lumens for remote driver) **2D010**=0-10V Dimming, 1% to 100%, 277V 7500 lumens (3500 to 7000 lumens for remote driver) **3D010**=0-10V Dimming, 1% to 100%, 347V dedicated drivers for 800 to 4000 lumens; 250, 500, 4500 and above use step down transformer (250 to 7000 lumens for remote driver)	250-7000
D010TR=0-10V Dimming, 5% to 100%,120V-277V or 120V line voltage dimming 250- 4500 lumens (up to 3000 lumens for remote driver) **1D010TR**=0-10V or line voltage Dimming, 5% to 100%, 120V 5000-7500 lumens (3500 to 4500 lumens for remote driver) **2D010TR**=0-10V Dimming, 5% to 100%, 277V 5000-7500 lumens (3500 to 4500 lumens for remote driver) **3D010TR**=0-10V or line voltage Dimming, 5% to 100%, 347V step down transformer 250-7500 lumens (250 to 4500 lumens for remote driver)	250-4500
DE010=0-10V Dimming, 0% to 100%, 120V-277V 500-7000 lumens (up to 3000 lumens for remote driver) **1DE010**=0-10V Dimming, 0% to 100%, 120V 7500 lumens (3500 to 7000 lumens for remote driver) **2DE010**=0-10V Dimming, 0% to 100%, 277V 7500 lumens (3500 to 7000 lumens for remote driver) **3DE010**=0-10V Dimming, 0% to 100%, 347V step down transformer, 500-7500 lumens (500 to 7000 lumens for remote driver)	500-7000
D5LT=Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V-277V, 500-7000 lumens (up to 3000 lumens for remote driver) **1D5LT**=Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V 7500 lumens (3500 to 7000 lumens for remote driver) **2D5LT**=Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 277V 7500 lumens (3500 to 7000 lumens for remote driver) **3D5LT**=Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100% 347V step down transformer, 500-7500 lumens (500 to 7000 lumens for remote driver)	500-7000
DMX=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V 800-4500 lumens (up to 3000 lumens for remote driver) [14] **1DMX**= DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) [14] **2DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) [14] **3DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 800-7500 lumens (800 to 4500 lumens for remote driver) [14]	800-4500
DMXC5=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, 800-4500 lumens, RJ45 Connection (up to 3000 lumens for remote driver) [14] **1DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 5000-7500 lumens, RJ45 Connection (3500 to 4500 lumens for remote driver) [14] **2DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 5000-7500 lumens, RJ45 Connection (3500 to 4500 lumens for remote driver) [14] **3DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 800-7500 lumens, RJ45 Connection (800 to 4500 lumens for remote driver) [14]	800-4500
1DL2 = Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 120V Only 800-7500 lumens (800 to 3500 lumens for remote driver) **3DL2** = Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 347V step down transformer, 800-7500 lumens (800 to 3500 lumens for remote driver)	800-3500
DLE=Lutron Ecosystem dimming 1% to 100%, 120V-277V, 800-3500 lumens (up to 3000 lumens for remote driver) **1DLE**=Lutron Ecosystem dimming 1% to 100%, 120V, 4000-7500 lumens (3500 lumens for remote driver) **2DLE**=Lutron Ecosystem dimming 1% to 100%, 277V, 4000-7500 lumens (3500 lumens for remote driver) **3DLE**=Lutron Ecosystem dimming 1% to 100%, 347, step down transformer, 800-7500 lumens (800-3500 lumens for remote driver)	800-3500
DLV = Low voltage dimming driver (1-100%) for use with DLVP system 800-3000 lumens [3]	800-3000 (Remote driver only)

Driver Options		Hanger Bars
Blank = Integral driver **RC100** = Remote 100ft [3] [33] **RC75** = Remote 75ft [3] [33] **RC50** = Remote 50ft [3] [33] **RC25** = Remote 25ft [3]	**RC15** = Remote 15ft [3] **RC5** = Remote 5ft [3] **RC2** = Remote 2ft [3] **PD** = Plug in Driver	**Blank** = Without hanger bars **B26** = C-channel Bar Hanger, 26" Long, Pair

Trim Distribution [5]	Trim Flange	Trim Finish	Options [3] [16] [31]
N=Narrow, Spun Aluminum [26] **M**=50° Cutoff, Medium Beam Reflector, Spun Aluminum **MD**=45° Cutoff, Medium Beam Reflector, Spun Aluminum **W**=Wide, Spun Aluminum **S**=Shallow, Spun Aluminum **HY**=Hyperbolic medium beam [12] **PS**=Non-Conductive Shallow, Injection Molded white [11] [12] **CS**=Cast Shallow, Die Cast Aluminum **BA**= Spun Aluminum Baffle [7] **Wall Wash** **SWN** = Single Wall Wash, Spun Aluminum **DWN** = Double Wall Wash, Spun Aluminum **CW** = Corner Wall Wash, Spun Aluminum **LSWW** = Lensed Single wall wash, Spun Aluminum **LDWW** = Lensed Double wall wash, Spun Aluminum	**0**=White Polymer Trim Ring **1**=Self-flanged [13] **2**=White Painted Self-flanged **4**=Knife edge rimless use with die cast only [8] [23]	**LI**=Specular Clear [9] **H**=Semi-Specular Clear [9] **WMH**=Warm Haze [9] **WH**=Wheat [9] **GPH**=Graphite Haze [9] **B**=Specular Black [9] **MW**=Matte White (Antimicrobial) **MB**=Matte Black [8] **MMS**=Matte Metallic Silver [8]	**EMBOD**=Bodine® Emergency Module with Remote Test Switch [25] **EMBOD6ST**=Bodine® 6W Self Test Emergency Module with Remote Test Switch **EM7**=7W Emergency Module with Remote Test Switch **EM14**=14W Emergency Module with Remote Test Switch **EMBOD7ST**=Bodine® Self Test Emergency Module [25] **IEMBOD**=Bodine® Emergency Module with Integral Test Switch [6] [25] **IEM7**=7W Emergency Module with Integral Test Switch [6] **IEM14**=14W Emergency Module with Integral Test Switch [6] **EMV7**=7W Low Voltage Emergency Module with Remote Test Switch [4] **EMV14**=14W Low Voltage Emergency Module with Remote Test Switch [4] **ETRD**=Emergency transfer device [32] **WPST** = Factory installed Wavelinx (includes control module, sensor, cable, tilemount and ceiling mount sensor) [15] [18] **WLST** = Factory installed WaveLinx LITE Sensor Kit [15] [17] **WPN** = WaveLinx PRO Wireless Node without sensor [20]

Continued on next page.

Single Line Order Information

Accessories (*Sold separately*) [22]

TRM4P=White metal trim ring [2]
LGSKT4IP66=IP66 Gasket Kit
DT4RF=6 inch frosted acrylic ring [29]

PRR4=Rimless Plaster Ring [2]
RKP4=Knife Edge plaster Ring [24]

RPM4MW=Rimless Millwork Ring, Matte White [2]
RPM4MB=Rimless Millwork Ring, Matte Black [2]
RKM4MW=Knife Edge Millwork Ring, Matte White [24]
RKM4MB=Knife Edge Millwork Ring, Matte Black [24]

HSA4=Slope Adapter for 4" Aperture Housings, Specify Slope [34]

Connected Lighting Systems [3] [15]
WPST = Field installed WaveLinx sensor Kit [17]
WLST = Field installed WaveLinx LITE Sensor Kit [18]

Transformers
H347=H347 for 5500 lumens and below
H347200=347 to 120V Step Down Transformer, 200VA

Bar Hangers
HB50=C-channel Bar Hanger, 50" Long, Pair
RMB22=Wood Joist Bar Hanger, 22" Long, Pair

Notes:
1. Nominal Lumens will vary depending on selected color, CRI, driver and reflector finish. Reference Multiplier tables.
2. Order trim with polymer trim ring (Consult specification sheet for color ordering information and options).
3. Not available with Chicago Plenum.
4. ULus listed only
5. Beam angles are nominal with LI finish trims.
6. Available with narrow (N), medium (M) and medium 45 degree (MD) Spun Aluminum trims. Required for use with all, IEMBOD, IEM7, IEM14,IEMV7 and IEMV14 housings. Not offered with remote driver.
7. Only available with Matte White and Matte Black Finishes.
8. Available only on CS distributions.
9. Not available on PS, CS or BA distributions.
10. Product is marked spacing. Reference table on page 4.
11. PS available in self-flanged MW finish only.
12. Offered up to 2000 lumens
13. Flange is the same finish as the reflector
14. DMX fixtures default to full on upon loss of DMX signal.
15. Refer to system specifications for additional information,features, and benefits. Order either factory installed option or accessory. Use with 0-10V driver.
16. Non-IC
17. WLST = WaveLinx LITE tilemount sensor kit for daylight dimming, PIR motion sensing, use with D010 only (Refer to WaveLinx LITE system specifications)
18. WPST = WaveLinx wireless sensor kit for daylight dimming, PIR motion sensing, and optional RLTS - Real Time Location Services, use with 0-10V only.
20. WPN = WaveLinx PRO wireless node provides luminaire-level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with 0-10V driver only.
22. Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information.
23. Accessory (Requires knife edge accessory ring)
24. Order die cast trim with flange type 4
25. Not available with 6500-7000 lumens, DLVP up to 3000 lumens
26. Offered with
- D010, D5LT, DE010 up to 7000 lumens
- D010TR, DMX up to 4500 lumens
- DLE, DL2 up to 3500 lumens
29. Order with self flanged trim.
31. 120V-277V
32. Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others)
33. Not available with Lutron drivers
34. Not recommended for use with Wall Wash

Product Specifications

Lower Shielding Reflector
- Painted die-cast aluminum or spun aluminum lower reflector with lensed upper optical chamber provides superior lumen output with minimal source brightness
- Spun reflectors are available in all Portfolio anodized finishes
- Hyperbolic reflector provides minimal aperture brightness and glare.
- Available with non-conductive polymer reflector up to 2000 lumens
- Plaster lathing ring, knife edge and millwork ring accessory for flush reflector transition
- Decorative frosted acrylic ring provides a light glow in the ceiling

Wall Wash Reflector
- **Open Wall Wash** - wall wash reflector with gradient kicker offered in single, double and corner wall wash provides even vertical illumination with minimal source brightness.
- **Rotatable Lensed Wall Wash** - Rotatable Lensed wall wash reflector offered in single and double wall wash provides even vertical illumination with minimal source brightness.

Trim Retention
- Two torsion springs hold reflector flange tightly to the finished ceiling surface

Plaster Frame/Collar
- Die-cast aluminum 1 ½" deep collar
- Accommodates up to 2" ceiling thickness

Universal Mounting Bracket
- Accepts 1/2" Electric Metallic Tube (EMT), C-channel and bar hangers
- Adjusts 5" vertically from above and below the ceiling

Junction box
- Four 1/2" and two 3/4" trade size pry outs positioned to allow straight conduit runs
- Lever connectors for simple push in wiring
- Listed for eight #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring

Thermal
- Aluminum heat sink conducts heat away from the LED module for improved performance and longer life

LED System
- Contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution without pixilation
- Auto resetting, thermally protected, LED's are turned off when safe operating temperatures are exceeded
- Quick disconnect allows for tool-less replacement of LED engine from below ceiling
- 90 and 97 CRI
- 90 & 97CRI: L78 55,000 hours for 1000-2000 lumens, L90 55,000 for all other lumen output
- Color variation within 2-step MacAdam ellipses
- Available in 2400K, 2700K, 3000K, 3500K, 4000K and 5000K correlated color temperature (CCT)

Vividtune and High CRI
- 98 CRI and W2N: L70 55,000 hours
- D2W™ – dim-to-warm shifts CCT from 3000K to 1850K as fixture dims mimicking halogen sources.
- W2N - Tunable white CCT range 2700K to 6500K or 2000K to 5000K, 90 CRI. Standard
- **98 CRI** With a full-spectrum approach using broad-blue chip technology and special phosphor blends, Thrive is able to closely match the spectrum of the sun across all color temperatures. Benefits of the natural spectrum of the sun using Thrive include superior accurate color rendering, reduced eye strain, and a higher sense of emotional well-being.
- See dedicated specification sheet for more details.

Driver
- Standard 120-277V 0-10V dimming driver provides flicker free dimming from 100% to 1%
- Optional 120V leading edge/0-10V, <1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem
- Driver can be serviced from above or through the aperture
- Distributed low voltage power system combines power, lighting, and controls with ease of installation.
- Optional magnetically guided snap in driver for ease of maintenance.

Emergency Option
- Provides 90 minutes of standby lighting, meeting most life safety codes for egress lighting
- Available with integral or remote charge indicator and test switch
- Available Self-Test with remote charge indicator and test switch
- Emergency transfer device (ETRD) senses the loss of power regardless of local control settings allowing emergency power to the fixture.
- UL 924 listed

Connected Lighting System
Two WaveLinx connected solutions to choose from. Refer to WaveLinx system specifications and application guides for details.

WaveLinx PRO Tilemount Sensor Kit
- WaveLinx WPST tilemount sensor kit offers daylight dimming, PIR motion sensing, scene and zone configuration, automatic commissioning; and optional RLTS - Real Time Location Services available.

WaveLinx PRO Wireless Node
- WaveLinx PRO wireless node provides luminaire-level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with 0-10V driver only.

WaveLinx LITE Tilemount Sensor Kit
- WaveLinx LITE WLST tilemount sensor kit offers daylight dimming and PIR motion sensing, scene and grouping configuration.

WaveLinx Tilemount Kits Application
- The WPST and WLST tilemount kits include a control module mounted on the luminaire junction box via 1/2" knock-out, and a tilemount sensor on 54-inch whip; for ceiling installation by direct-mount spring clips or via mounting bracket in octagon ceiling boxes.
- The WPST and WLST tilemount kits may be ordered as factory installed on the luminaire, or ordered separately as a field installed accessory kit.

Code Compliance
- Thermally protected
- cULus Certified to UL 1598 / C22.2 No. 250.0 suitable for wet locations with downlight; damp location with wall wash and hyperbolic with covered ceiling
- IP66 rated when used with IP66 gasket kit accessory
- Optional City of Chicago environmental air (CCEA) marking for plenum applications
- FCC CFR Title 47 Part 15 Class B at 120VAC and Class A at 277VAC
- Insulated ceiling (IC) rated up to 1,500 lumens (90 and 97CRI). All others are non-IC rated (insulation must be kept 3" from top and sides of housing).
- Can be used for State of California Title 24 high efficacy LED compliance under JA8, reference Modernized Appliance Efficiency Database System (MAEDBS) for 2016 JA8 High Efficacy Lighting
- RoHS compliant
- Photometric testing completed in accordance with IES LM-79
- LED life testing completed in accordance with IES LM-80-08 and TM-21-11 standards
- See table on page 3 for marked spacing requirements

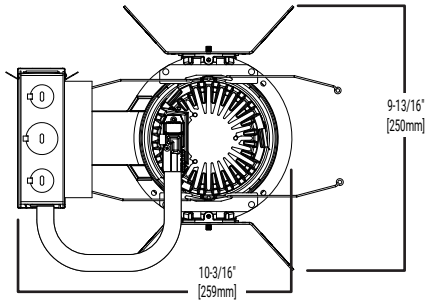
Warranty
- Five year warranty www.cooperlighting.com/legal

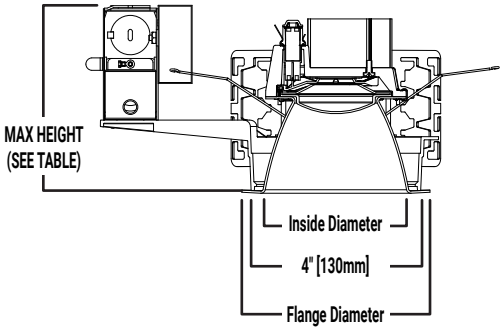
Marked Spacing

4-inch Marked spacing for 90 and 97 CRI			
4000	36	36	0.5
4000-7500 (Lutron)	36	36	8
4500-7500	36	36	8

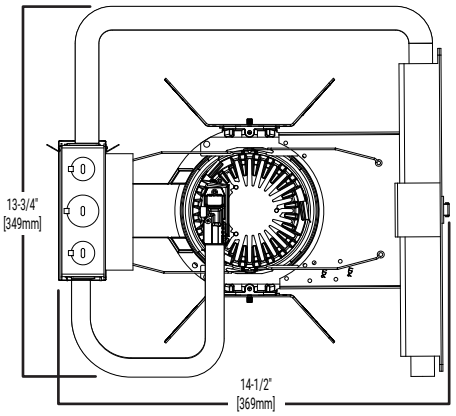
Dimensional and Mounting Details

DOWNLIGHT

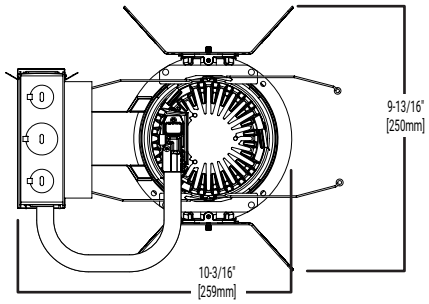


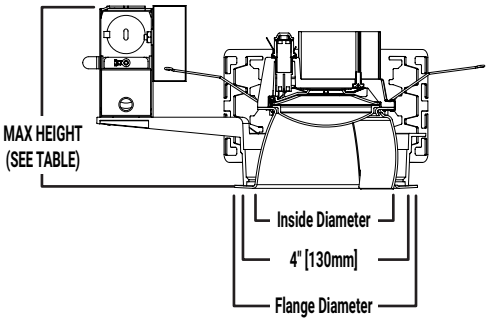


EM OPTION



WALL WASH





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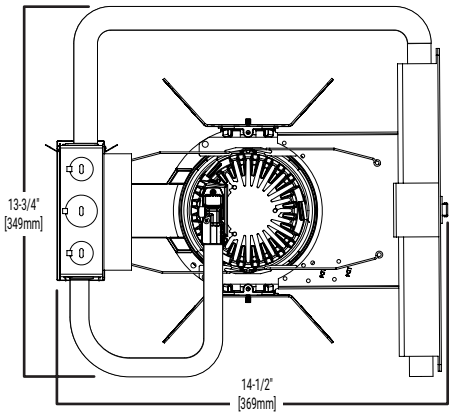
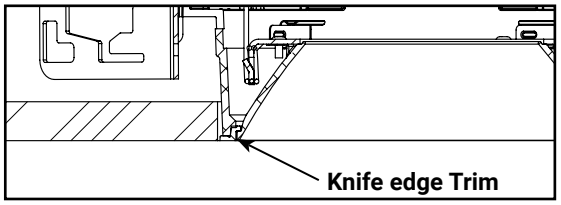
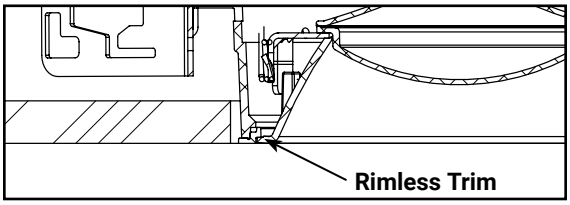






CATALOG #	Flange DIAMETER or WIDTH [IN]	INSIDE DIAMETER or WIDTH [IN]	MAX HEIGHT				
			250-2000 LUMENS (90/97CRI)	2500-4000 LUMENS (90/97CRI)	4500-6000 LUMENS (90/97CRI)	1000-1500IC LUMENS (90/97CRI) 6500-7000 LUMENS (90/97CRI)	2 LEDs 4500-7500 LUMENS (90/97CRI)
4LBN	5.67	4.24	5.6	5.6	5.6	6.1	8.1
4LBM	5.67	4.26	5.6	5.6	5.6	6.1	8.1
4LBW	5.67	4.27	5.6	5.6	5.6	5.7	7.7
4LBBA	5.67	4.28	5.6	5.6	5.6	6.1	8.1
4LBMD	5.67	4.26	5.8	5.9	6.4	6.9	8.9
4LBHY	5.67	4.34	5.6	5.6	5.6	6.1	8.1
4LBS	5.67	4.23	5.6	5.6	5.6	5.6	6.4
4LBPS	5.67	4.23	5.6	5.6	5.6	5.6	6.5
4LBCS	5.67	4.23	5.6	5.6	5.6	5.6	6.5
4LBSWN	5.67	4.27	5.6	5.6	5.6	5.7	7.7
4LBDWN	5.67	4.27	5.6	5.6	5.6	5.7	7.7
4LBCW	5.67	4.01	5.6	5.6	5.6	5.7	7.7
4LBLSWW	5.67	4.27	5.6	5.6	5.6	5.7	7.7
4LBLDWW	5.67	4.27	5.6	5.6	5.6	5.7	7.7

Energy and Performance Data

D010 DRIVER ENERGY DATA

Series	250 lumen		500 lumen		800 lumen		1000 lumen		1500 lumen		2000 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V
Input Current (A)	0.029	0.017	0.061	0.032	0.085	0.041	0.084	0.042	0.135	0.063	0.189	0.084
Input Power (W)	3.45	3.87	7.33	7.78	10.15	10.52	10.04	10.43	16.17	16.56	22.58	22.63
In-rush (A)	2.1	8.5	3.7	8.5	3.6	8.3	3.6	8.4	2.3	9.5	2.1	9.7
Inrush duration (µs)	250	131	190	136	220	135	226	136	230	125	243	132
THDi (%)	7.21	16.92	7.82	10.78	5.57	9.63	7.78	9.24	4.75	9.93	8.03	7.44
PF	≥ 0.98	≥ 0.9	≥ 0.99	≥ 0.93	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.94	≥ 0.99	≥ 0.96

Series	2500 lumen		3000 lumen		3500 lumen		4000 lumen		4500 lumen		5000 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V
Input Current (A)	0.276	0.121	0.276	0.121	0.333	0.152	0.404	0.181	0.421	0.192	0.491	0.216
Input Power (W)	32.98	32.57	32	32.57	39.83	39.84	48.38	47.94	50.22	50.17	58.69	58.01
In-rush (A)	2.5	11.8	3.6	11.8	3.1	14.3	3.1	14.5	5.6	22.6	5.6	22.6
Inrush duration (µs)	215	111	220	111	200	94	197	95	215	120	213	135
THDi (%)	9.86	6.57	5.57	6.57	4.25	10.05	5.02	7.97	6.12	8.35	8.51	7.92
PF	≥ 0.99	≥ 0.97	≥ 0.99	≥ 0.99	≥ 0.99	≥ 0.94	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.96

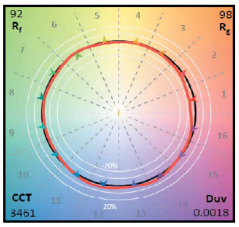
Series	5500 lumen		6000 lumen		6500 lumen		7000 lumen		7500 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V
Input Current (A)	0.526	0.231	0.542	0.256	0.572	0.266	0.632	0.292	0.668	0.306
Input Power (W)	62.97	61.97	64.88	65.7	68.35	69.02	75.56	75.85	79.89	80.09
In-rush (A)	5.1	23.1	6.2	27.5	6.3	28.4	6.4	29.1	6.4	28.7
Inrush duration (µs)	217	138	188	101	189	92	187	90	185	100
THDi (%)	9.42	7.16	4.33	11.86	4.38	11.33	4.84	10.32	4.46	9.85
PF	≥ 0.99	≥ 0.96	≥ 0.99	≥ 0.93	≥ 0.99	≥ 0.93	≥ 0.99	≥ 0.94	≥ 0.99	≥ 0.94

Minimum starting temperature -30°C (-22°F)* (Nominal input 120-277VAC & 100% of rated output power)
Sound Rating: Class A standards

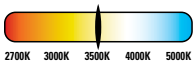
Notes:
Emergency Battery packs are rated for a minimum starting temperature of 0°C.

COLOR METRICS - TM-30-15 & CRI/CIE

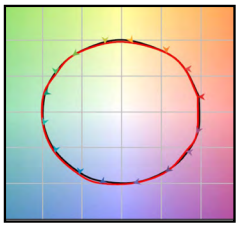
90 CRI Color Metric Summary - 3500K*



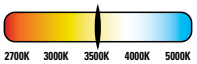
TM-30-15	Rf = 92
	Rg = 98
CRI/CIE	Ra = 92.2
	R9 = 51.4



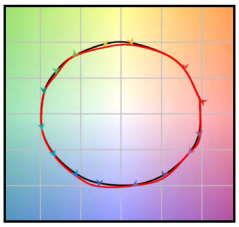
97 CRI Color Metric Summary - 2700K*



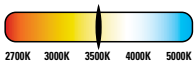
TM-30-15	Rf = 95
	Rg = 99.8
CRI/CIE	Ra = 92.2
	R9 = 85.8



97 CRI Color Metric Summary - 3000K*



TM-30-15	Rf = 93.9
	Rg = 100.2
CRI/CIE	Ra = 92.2
	R9 = 98.7



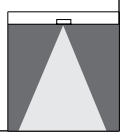
* Color values are based on haze reflector, other finishes and field results may vary.

Photometric Data

View IES files

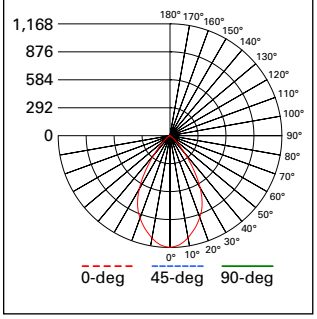
MEDIUM BEAM 50° CUTOFF 65° BEAM (H)

Test Number	P571636
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBMH
Lumens	1178
Efficacy	74.6 Lm/W
SC	0.95
UGR	11.9

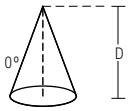


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	73	3.6	3.6
7'	23.8	6.6	6.6
9'	14.4	8.4	8.4
13'	6.9	12.2	12.2
16'	4.6	15	15

CANDELA TABLE

Degrees Vertical	Candela
0	1168
5	1147
15	1006
25	800
35	437
45	135
55	32
65	9
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

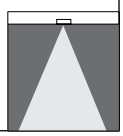
Zone	Lumens	% Fixture
0-30	752	63.8
0-40	1024	87
0-60	1165	98.9
0-90	1178	100
90-180	0	0
0-180	1178	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	55459
45	23472
55	6854
65	2587
75	854
85	0

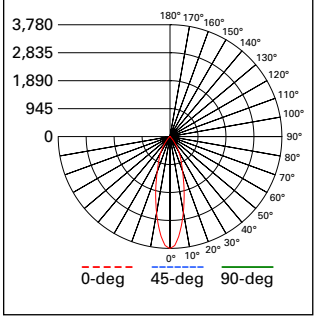
MEDIUM BEAM 50° CUTOFF 45° BEAM (LI)

Test Number	P571637
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBMLI
Lumens	1469
Efficacy	93 Lm/W
SC	0.48
UGR	0

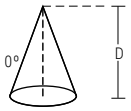


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	236.3	1.8	1.8
7'	77.2	3.2	3.2
9'	46.7	4.2	4.2
13'	22.4	6.2	6.2
16'	14.8	7.6	7.6

CANDELA TABLE

Degrees Vertical	Candela
0	3780
5	3389
15	1844
25	873
35	339
45	38
55	2
65	2
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

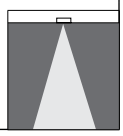
Zone	Lumens	% Fixture
0-30	1213	82.6
0-40	1428	97.2
0-60	1468	99.9
0-90	1469	100
90-180	0	0
0-180	1469	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	38008
45	6672
55	493
65	669
75	0
85	0

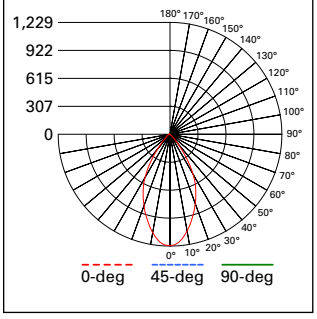
NARROW 55° BEAM (H)

Test Number	P571638
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBNH
Lumens	979
Efficacy	62 Lm/W
SC	0.81
UGR	8.2

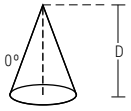


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	76.8	3.2	3.2
7'	25.1	5.6	5.6
9'	15.2	7.2	7.2
13'	7.3	10.4	10.4
16'	4.8	12.8	12.8

CANDELA TABLE

Degrees Vertical	Candela
0	1229
5	1197
15	963
25	685
35	332
45	67
55	16
65	5
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

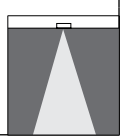
Zone	Lumens	% Fixture
0-30	692	70.7
0-40	899	91.8
0-60	972	99.2
0-90	979	100
90-180	0	0
0-180	979	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	39457
45	11710
55	3406
65	1541
75	854
85	0

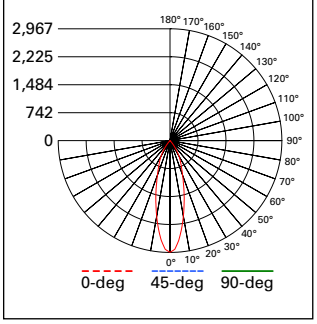
NARROW 30° BEAM (LI)

Test Number	P571639
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBNLI
Lumens	1153
Efficacy	73 Lm/W
SC	0.48
UGR	0



CANDLEPOWER DISTRIBUTION

Downlight



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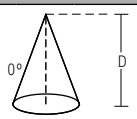

D	FC	L	W
4'	185.4	1.8	1.8
7'	60.6	3.2	3.2
9'	36.6	4.2	4.2
13'	17.6	6.2	6.2
16'	11.6	7.6	7.6

CANDELA TABLE

Degrees Vertical	Candela
0	2967
5	2660
15	1447
25	685
35	266
45	30
55	2
65	2
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	952	82.6
0-40	1121	97.2
0-60	1152	99.9
0-90	1153	100
90-180	0	0
0-180	1153	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	29831
45	5247
55	386
65	523
75	0
85	0

Photometric Data

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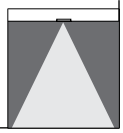
SHALLOW 85° BEAM (H)

Test Number	P571640
Housing	LD4C15D010
Module	EU4B10209035
Trim	4LBSH
Lumens	1538
Efficacy	97.3 Lm/W
SC	1.06
UGR	26.5



CANDLEPOWER DISTRIBUTION

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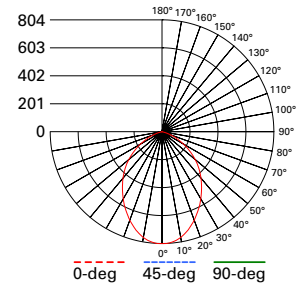

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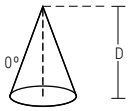


D	FC	L	W
4'	50.3	4.2	4.2
7'	16.4	7.4	7.4
9'	9.9	9.4	9.4
13'	4.8	13.6	13.6
16'	3.1	16.8	16.8

CANDELA TABLE

Degrees Vertical	Candela
0	804
5	798
15	730
25	618
35	496
45	376
55	246
65	120
75	29
85	0
90	0

ZONAL LUMEN SUMMARY

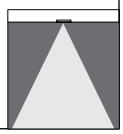
Zone	Lumens	% Fixture
0-30	565	36.7
0-40	875	56.9
0-60	1384	90
0-90	1538	100
90-180	0	0
0-180	1538	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	72577
45	65309
55	52605
65	34942
75	13670
85	0

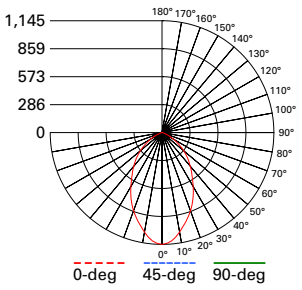
SHALLOW 65° BEAM (LI)

Test Number	P571641
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBSLI
Lumens	1604
Efficacy	101.5 Lm/W
SC	0.91
UGR	23.9

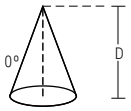


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	71.6	3.6	3.6
7'	23.4	6.2	6.2
9'	14.1	8.2	8.2
13'	6.8	11.8	11.8
16'	4.5	14.4	14.4

CANDELA TABLE

Degrees Vertical	Candela
0	1145
5	1115
15	945
25	749
35	534
45	371
55	208
65	73
75	4
85	0
90	0

ZONAL LUMEN SUMMARY

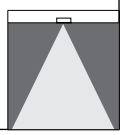
Zone	Lumens	% Fixture
0-30	712	44.4
0-40	1048	65.3
0-60	1520	94.8
0-90	1604	100
90-180	0	0
0-180	1604	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	77201
45	64475
55	44508
65	21163
75	1709
85	0

WIDE 80° BEAM (H)

Test Number	P571642
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBWH
Lumens	1309
Efficacy	82.8 Lm/W
SC	1.18
UGR	17.9



CANDLEPOWER DISTRIBUTION

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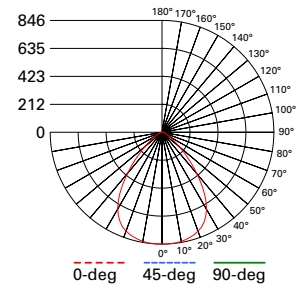

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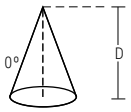


D	FC	L	W
4'	52.7	4.6	4.6
7'	17.2	8.2	8.2
9'	10.4	10.4	10.4
13'	5	15.2	15.2
16'	3.3	18.8	18.8

CANDELA TABLE

Degrees Vertical	Candela
0	844
5	844
15	821
25	748
35	547
45	265
55	84
65	23
75	7
85	0
90	0

ZONAL LUMEN SUMMARY

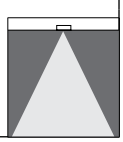
Zone	Lumens	% Fixture
0-30	653	49.9
0-40	991	75.7
0-60	1276	97.5
0-90	1309	100
90-180	0	0
0-180	1309	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	75186
45	45989
55	17885
65	6715
75	3370
85	0

WIDE 80° BEAM (LI)

Test Number	P571643
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBWLI
Lumens	1551
Efficacy	98.2 Lm/W
SC	1.29
UGR	6.9



CANDLEPOWER DISTRIBUTION

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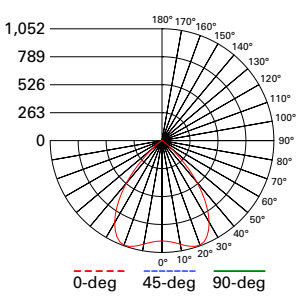

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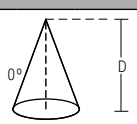

D	FC	L	W
4'	59.5	5	5
7'	19.4	9	9
9'	11.8	11.6	11.6
13'	5.6	16.6	16.6
16'	3.7	20.6	20.6

CANDELA TABLE

Degrees Vertical	Candela
0	950
5	963
15	1036
25	1005
35	723
45	279
55	28
65	4
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	844	54.4
0-40	1289	83.1
0-60	1546	99.7
0-90	1551	100
90-180	0	0
0-180	1551	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	-
45	-
55	-
65	-
75	-
85	-

Photometric Data

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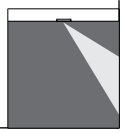
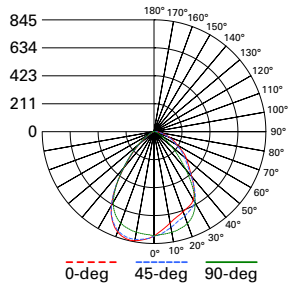
SINGLE WALL WASH (H)

Test Number	P571644
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LCSWH
Lumens	1390
Efficacy	88 Lm/W
SC	1.17
UGR	29.6



CANDLEPOWER DISTRIBUTION

Downlight



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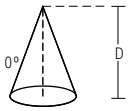


D	FC	L	W
4'	51	4.4	4.6
7'	16.6	7.9	8
9'	10.1	10.1	10.2
13'	4.8	14.7	15
16'	3.2	18.1	18.4

CANDELA TABLE

Degrees Vertical	Candela
0	793
5	746
15	669
25	625
35	527
45	371
55	262
65	159
75	74
85	17
90	0

ZONAL LUMEN SUMMARY

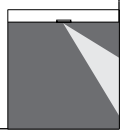
Zone	Lumens	% Fixture
0-30	608	43.8
0-40	928	66.7
0-60	1283	92.3
0-90	1390	100
90-180	0	0
0-180	1390	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	75835
45	64441
55	56032
65	46337
75	34936
85	24527

SINGLE WALL WASH (LI)

Test Number	P571645
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LCSWLI
Lumens	1445
Efficacy	91.5 Lm/W
SC	1.3
UGR	28.3



CANDLEPOWER DISTRIBUTION

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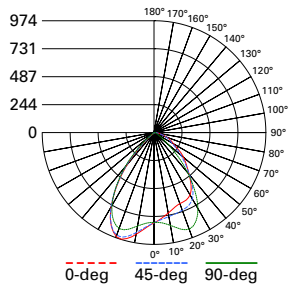

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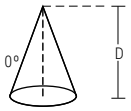


D	FC	L	W
4'	54.2	4.5	4.8
7'	17.7	8	8.6
9'	10.7	10.3	11
13'	5.1	14.9	16
16'	3.4	18.4	19.6

CANDELA TABLE

Degrees Vertical	Candela
0	783
5	745
15	673
25	648
35	548
45	384
55	235
65	143
75	57
85	10
90	0

ZONAL LUMEN SUMMARY

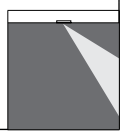
Zone	Lumens	% Fixture
0-30	680	47.1
0-40	1041	72.1
0-60	1362	94.2
0-90	1445	100
90-180	0	0
0-180	1445	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	78745
45	66786
55	50356
65	41599
75	27151
85	14378

LENSED WALL WASH (LI)

Test Number	P571646
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBLWWLI
Lumens	1246
Efficacy	78.9 Lm/W
SC	1.12
UGR	26.3



CANDLEPOWER DISTRIBUTION

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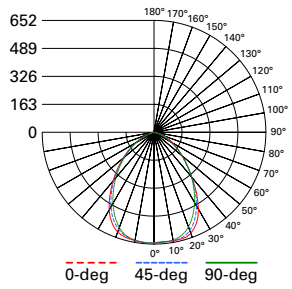

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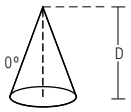


D	FC	L	W
4'	40.7	4.6	4.4
7'	13.3	8.2	7.8
9'	8	10.6	10
13'	3.8	15.4	14.4
16'	2.5	19	17.8

CANDELA TABLE

Degrees Vertical	Candela
0	650
5	644
15	647
25	591
35	439
45	278
55	174
65	99
75	42
85	3
90	0

ZONAL LUMEN SUMMARY

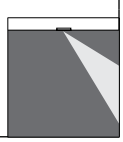
Zone	Lumens	% Fixture
0-30	499	40
0-40	766	61.5
0-60	1139	91.4
0-90	1246	100
90-180	0	0
0-180	1246	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	61806
45	48248
55	37226
65	28866
75	19936
85	4088

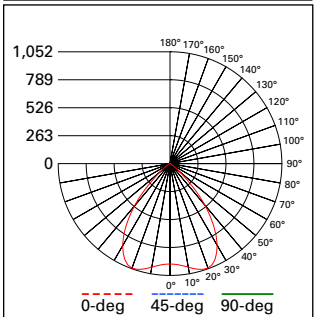
LENSED WALL WASH (H)

Test Number	P571647
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBLWWH
Lumens	1196
Efficacy	75.7 Lm/W
SC	1.09
UGR	26.5



CANDLEPOWER DISTRIBUTION

Downlight



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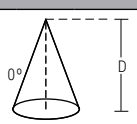

D	FC	L	W
4'	39.7	4.5	4.2
7'	13	8	7.6
9'	7.8	10.2	9.8
13'	3.8	14.8	14
16'	2.5	18.3	17.4

CANDELA TABLE

Degrees Vertical	Candela
0	635
5	639
15	639
25	586
35	441
45	280
55	174
65	100
75	43
85	4
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	471	39.4
0-40	724	60.5
0-60	1084	90.6
0-90	1196	100
90-180	0	0
0-180	1196	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	62135
45	48734
55	37269
65	29099
75	20268
85	5497

Photometric Data

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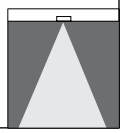
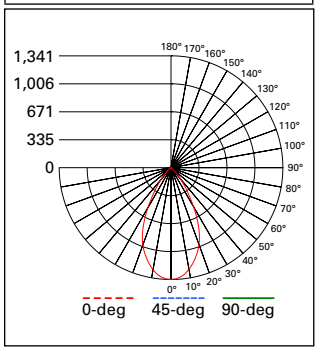
MEDIUM BEAM 45° CUTOFF 55° BEAM (H)

Test Number	P571648
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBMDH
Lumens	1113
Efficacy	70.4 Lm/W
SC	0.86
UGR	9.5

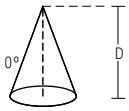


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	83.8	3.4	3.4
7'	27.4	6	6
9'	16.6	7.6	7.6
13'	7.9	11	11
16'	5.2	13.6	13.6

CANDELA TABLE

Degrees Vertical	Candela
0	1341
5	1318
15	1127
25	791
35	337
45	91
55	20
65	7
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

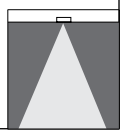
Zone	Lumens	% Fixture
0-30	793	71.3
0-40	1008	90.6
0-60	1103	99.1
0-90	1113	100
90-180	0	0
0-180	1113	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	41780
45	15758
55	4284
65	2064
75	1044
85	423

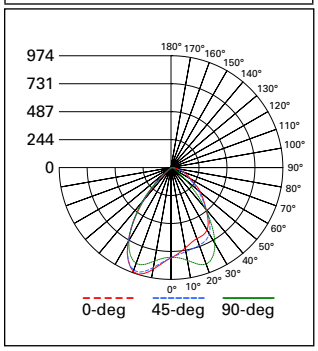
MEDIUM BEAM 45° CUTOFF 50° BEAM (LI)

Test Number	P571649
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBMDLI
Lumens	1294
Efficacy	81.9 Lm/W
SC	0.84
UGR	0.4

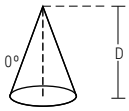


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	108.2	3.2	3.2
7'	35.3	5.6	5.6
9'	21.4	7.4	7.4
13'	10.2	10.6	10.6
16'	6.8	13.2	13.2

CANDELA TABLE

Degrees Vertical	Candela
0	1700
5	1751
15	1545
25	945
35	323
45	47
55	6
65	2
75	1
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	1023	79.1
0-40	1243	96
0-60	1291	99.8
0-90	1294	100
90-180	0	0
0-180	1294	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	36556
45	8096
55	1199
65	640
75	285
85	0

Photometric Multipliers (Nominal Lumen Values)

250 Lumen	500 Lumen	800 Lumen	1000 Lumen	1500 Lumen	2000 Lumen	2500 Lumen	3000 Lumen	3500 Lumen
0.22	0.42	0.57	0.65	1.00	1.29	1.62	1.90	2.25

4000 Lumen	4500 Lumen	5000 Lumen	5500 Lumen	6000 Lumen	6500 Lumen	7000 Lumen	7500 Lumen
2.61	3.02	3.42	3.82	4.13	4.32	4.54	5.34

Multipliers for relative lumen values with other series models.

CCT Multipliers – 90CRI

2400K	2700K	3000K	3500K	4000K	5000K
0.912	0.949	0.986	1	1.001	1.022

Multipliers for relative lumen values with other series color temperatures.

CCT Multipliers – 97CRI

2700K	3000K	3500K	4000K	5000K
0.889	0.955	1	1.016	1.07

Multipliers for relative lumen values with other series color temperatures.

Color Finish Multipliers (*from H = Semi Specular Clear*)

Finish code	LI	H	WMH	WH	GPH	B	MW
Finish	Specular Clear	Semi-Specular Clear	Warm Haze	Wheat	Graphite Haze	Specular Black	Matte White
Multiplier	1.25	1.00	1.02	1.02	0.72	0.55	0.95

Multipliers for relative lumen values with other color finishes.

Multi-line Order Information

Single line Ordering Information Option

SAMPLE ORDER NUMBER: **LD4C10D010TRIEM14 (All components may ship separately)**

Invoice will indicate separate fixture components (housing, trim, module) and may ship from multiple CLS facilities in separate cartons.

Domestic Preferences [1]	Housing	Lumens [2]		
[Blank]=Standard **BAA**=Buy American Act **TAA**=Trade Agreements Act	**LD4C**=LED Downlight 4-inch Nominal Aperture **LD4CCP**=LED Downlight 4-inch Nominal Aperture, Chicago Plenum	**02**=250 lumens **05**=500 lumens **08**=800 lumens **10**=1000 lumens **15**=1500 lumens **20**=2000 lumens	**25**=2500 lumens **30**=3000 lumens **35**=3500 lumens **40**=4000 lumens **45**=4500 lumens [3] **50**=5000 lumens [3]	**55**=5500 lumens [3] **60**=6000 lumens [3] **65**=6500 lumens [3] **70**=7000 lumens [3] **75**=7500 lumens [3]

Driver	Driver Options
D010 = 0-10V Dimming, 1% to 100%, 120V-277V, up to 7000 lumens (up to 3000 lumens for remote driver) **1D010** = 0-10V or line voltage Dimming, 1% to 100%, 120V, 7500 lumens (3500 to 7000 lumens for remote driver) **2D010** = 0-10V Dimming, 1% to 100%, 277V, 7500 lumens (3500 to 7000 lumens for remote driver) **3D010** = 0-10V Dimming, 1% to 100%, 347V dedicated drivers for 800 to 4000 lumens; 250, 500, 4500 and above use step down transformer (250 to 7000 lumens for remote driver) **1 driver:** 250-7000 / **2 drivers:** 7500	**Blank**=Integral driver **R**=Remote driver (offered with single driver, order remote driver separately) [6] **PD**=Plug in Driver (offered with single driver) [8]
D010TR = 0-10V Dimming, 5% to 100%,120V-277V or 120V line voltage dimming, 250- 4500 lumens (up to 3000 lumens for remote driver) **1D010TR** = 0-10V or line voltage Dimming, 5% to 100%, 120V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) **2D010TR** = 0-10V or line voltage Dimming, 5% to 100%, 277V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) **3D010TR** = 0-10V Dimming, 5% to 100%, 347V step down transformer, 250-7500 lumens (250 to 4500 lumens for remote driver) **1 driver:** 250-4500 / **2 drivers:** 5000-7500	
DE010 = 0-10V Dimming, 0% to 100%, 120V-277V, 500-7000 lumens (up to 3000 lumens for remote driver) **1DE010** = 0-10V Dimming, 0% to 100%, 120V, 7500 lumens (3500 to 7000 lumens for remote driver) **2DE010** = 0-10V Dimming, 0% to 100%, 277V, 7500 lumens (3500 to 7000 lumens for remote driver) **3DE010** = 0-10V Dimming, 0% to 100%, 0-10V Dimming, 347V step down transformer, 500-7500 lumens (500 to 7000 lumens for remote driver) **1 driver:** 500-7000 / **2 drivers:** 7500	
D5LT = Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V-277V, 500-7000 lumens (up to 3000 lumens for remote driver) **1D5LT** = Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V, 7500 lumens (3500 to 7000 lumens for remote driver) **2D5LT** =Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 277V, 7500 lumens (3500 to 7000 lumens for remote driver) **3D5LT** =Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100% 347V step down transformer, 500-7500 lumens (500 to 7000 lumens for remote driver) **1 driver:** 500-7000 / **2 drivers:** 7500	
DMX=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, 800-4500 lumens (up to 3000 lumens for remote driver) [5] **1DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) [5] **2DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) [5] **3DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 800-7500 lumens, RJ45 Connection (800 to 4500 lumens for remote driver) [5] **1 driver:** 800-4500 / **2 drivers:** 5000-7500	
DMXC5=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, up to 800-4500 lumens, RJ45 Connection (up to 3000 lumens for remote driver) [5] **1DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 5000-7500 lumens, RJ45 Connection (3500 to 4500 lumens for remote driver) [5] **2DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 5000-7500 lumens, RJ45 Connection (3500 to 4500 lumens for remote driver) [5] **3DMXCF**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 250-7500 lumens, RJ45 Connection (800 to 4500 lumens for remote driver) [5] **1 driver:** 800-4500 / **2 drivers:** 5000-7500	
1DL2=Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 120V Only, 800-7500 lumens (800 to 3500 lumens for remote driver) **3DL2** = Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 347V step down transformer, 800-7500 lumens (800 to 3500 lumens for remote driver) **1 driver:** 800-3500 / **2 drivers:** 4000-7500	
DLE=Lutron Ecosystem dimming 1% to 100%, 120V-277V, 800-3500 lumens (up to 3000 lumens for remote driver) **1DLE**=Lutron Ecosystem dimming 1% to 100%, 120V, 4000-7500 lumens (3500 lumens for remote driver) **2DLE**=Lutron Ecosystem dimming 1% to 100%, 120V-277V, 4000-7500 lumens (3500 lumens for remote driver) **3DLE**=Lutron Ecosystem dimming 1% to 100%, 347V, step down transformer, 800-7500 lumens (800-3500 lumens for remote driver) **1 driver:** 800-3500 / **2 drivers:** 4000-7500	
DLV=Low voltage dimming driver (1-100%) for use with DLVP system 800-3000 lumens [6]	

Options [6]	
EMBOD=Bodine® Emergency Module with Remote Test Switch [10]	**IEM7**=7W Emergency Module with Integral Test Switch [22]
EMBOD6ST=Bodine® 6W Self Test Emergency Module with Remote Test Switch	**IEM14**=14W Emergency Module with Integral Test Switch [22]
EM7=7W Emergency Module with Remote Test Switch	**EMV7**=7W Low Voltage Emergency Module with Remote Test Switch [7]
EM14=14W Emergency Module with Remote Test Switch	**EMV14**=14W Low Voltage Emergency Module with Remote Test Switch [7]
EMBOD7ST=Bodine® Self Test Emergency Module [10]	**ETRD**=Emergency transfer device [31]
IEMBOD=Bodine® Emergency Module with Integral Test Switch [10] [22]	**WPST** =Factory installed Wavelinx (includes control module, sensor, cable, tilemount and ceiling mount sensor) [11] [13] **WLST** =Factory installed WaveLinx LITE Sensor Kit [11] [12] **WPN** = WaveLinx PRO Wireless Node without sensor [34]

Continued on next page.

Multi-line Order Information

SAMPLE ORDER NUMBER: **EU4C10209035**

Domestic Preferences [1]	Power Module	Lumen Levels [2]	CRI [2]	Color	
[Blank]=Standard **BAA**=Buy American Act **TAA**=Trade Agreements Act	**EU4C**=4-inch Universal LED Module	**For use with one driver** **0208IC**=250, 500, 800 lumens, IC Rated (for use with all drivers, min 500 lumen with DE010 and D5LT, min 800 lumens with DLVP, Lutron and DMX) **1020**= 1000, 1500, 2000 lumens **1015IC**=1000, 1500 lumens IC Rated **2540**=2500, 3000, 3500, 4000 lumens (For use with Lutron 3000-3500, DLVP 3000 lumens, DMX, D010, D010TR, D5LT and DE010 3000-4000) **4560**=4500, 5000, 5500, 6000 lumens (For use with DMX and D010TR 4500 lumens, D010, D5LT and DE010 4500-6000) [3] **6570**=6500, 7000 lumens (For use with D010, D5LT and DE010) [3] **For use with two drivers** **4075**=4000, 4500, 5000, 5500, 6000, 6500, 7000, 7500 lumens (For use with Lutron 4000-7500, D010TR & DMX 5000, D010, D5LT & DE010 7500 lumen) [3]	**90**=90 CRI Minimum **97**=97 CRI Minimum	**90 CRI** **24**=2400K **27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K	**97 CRI** **27**=2700K **30**=3000K

SAMPLE ORDER NUMBER: **4LBM2H**

Domestic Preferences [1]	Trim	Reflector		Flange	Finish	Options
[Blank]=Standard **BAA**=Buy American Act	**4LB**=4" LED	**N**=Narrow, Spun Aluminum [29] **M**=50° Cutoff, Medium Beam Reflector, Spun Aluminum **MD**=45° Cutoff, Medium Beam Reflector, Spun Aluminum **W**=Wide, Spun Aluminum **S**=Shallow, Spun Aluminum **HY**=Hyperbolic medium beam [29] **PS**=Non-Conductive Shallow, Injection Molded white [16] [17] **CS**=Cast Shallow, Die Cast Aluminum **BA**= Spun Aluminum Baffle [24]	**Wall Wash** **SWN**=Single wall wash, spun aluminum **DWN**=Double wall wash, spun aluminum **CW**=Corner wall wash, spun aluminum **LSWW**=Lensed single wall wash, spun aluminum **LDWW**=Lensed double wall wash, spun aluminum	**0**=White polymer trim ring **1**=Self flanged [18] **2**=White painted self flanged **4**=Knife edge rimless use with die cast only [19]	**LI**=Specular Clear [20] **H**=Semi-Specular Clear [20] **WMH**=Warm Haze [20] **WH**=Wheat [20] **GPH**=Graphite Haze [20] **B**=Specular Black [20] **MW**=Matte White **MB**=Matte Black [21] **MMS**=Matte Metallic Silver [21]	**E**=Integral Emergency Test Switch Hole [22]

REQUIRED if Remote Driver (R) is specified

SAMPLE ORDER NUMBER: **RC10010D010TREM7**

Domestic Preferences [1]	Remote Drivers	Lumens [2] [14]		
[Blank]=Standard **BAA**=Buy American Act **TAA**=Trade Agreements Act	**RC100**=Remote 100ft **RC75**=Remote 75ft **RC50**=Remote 50ft **RC25**=Remote 25ft **RC15**=Remote 15ft **RC5**=Remote 5ft **RC2**=Remote 2ft	**02**=250 lumens **05**=500 lumens **08**=800 lumens **10**=1000 lumens **15**=1500 lumens	**20**=2000 lumens **25**=2500 lumens **30**=3000 lumens **35**=3500 lumens **40**=4000 lumens **45**=4500 lumens	**50**=5000 lumens **55**=5500 lumens **60**=6000 lumens **65**=6500 lumens **70**=7000 lumens

Continued on next page.

Multi-line Order Information

Driver
D010 = 0-10V Dimming, 1% to 100%, 120V-277V, 250-3000 lumens **1D010** = 0-10V Dimming, 1% to 100%, 120V, 3500-7000 lumens **2D010** = 0-10V Dimming, 1% to 100%, 277V, 3500-7000 lumens **3D010** = 0-10V Dimming, 1% to 100%, 347V dedicated drivers for 800 to 3000 lumens; 250, 500, 3500-7000 lumens use step down transformer
D010TR = 0-10V Dimming, 5% to 100%,120V-277V or 120V line voltage dimming, 120V-277V, 250- 3000 lumens **1D010TR** = 0-10V or line voltage Dimming, 5% to 100%, 120V, 3500-4500 lumens **2D010TR** = 0-10V Dimming, 5% to 100%, 277V, 3500-4500 lumens **3D010TR** = 0-10V or line voltage Dimming, 5% to 100% 347V step down transformer, 250-4500 lumens
DE010 = 0-10V Dimming, 0% to 100%, 120V-277V, 500-3000 lumens **1DE010** = 0-10V Dimming, 0% to 100%, 120V, 3500-7,000 lumens **2DE010** = 0-10V Dimming, 0% to 100%, 277V, 3500-7,000 lumens **3DE010** = 0-10V Dimming, 0% to 100%, 347V step down transformer, 500-7,000 lumens
D5LT = Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V-277V, 500-3000 lumens **1D5LT** = Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V, 3500-7,000 lumens **2D5LT** =Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 277V, 3500-7,000 lumens **3D5LT** =Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100% 347V step down transformer, 500-7,000 lumens
DMX = DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, 800-3000 lumens [5] **1DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 3500-4500 [5] **2DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 3500-4500 [5] **3DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 800-4500 [5]
DMXC5 = DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V up to 800-3000 lumens, RJ45 Connection [5] **1DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 3500-4500 lumens, RJ45 Connection [5] **2DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 3500-4500 lumens, RJ45 Connection [5] **3DMXCF**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 800-4500 lumens, RJ45 Connection [5]
1DL2=Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 120V Only, 25' Max remote length, 800-3500 lumens **3DL2** = Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 347V step down transformer, 25' Max remote length, 800-3500 lumens
DLE = Lutron Ecosystem dimming 1% to 100%, 120V-277V, 25' Max remote length, 800-3000 lumens **1DLE**=Lutron Ecosystem dimming 1% to 100%, 120V, 25' Max remote length, 3500 lumens **2DLE**=Lutron Ecosystem dimming 1% to 100%, 277V, 25' Max remote length, 3500 lumens **3DLE**=Lutron Ecosystem dimming 1% to 100%, 347V, step down transformer, 25' Max remote length, 800-3500 lumens
DLV = Low voltage dimming driver (1-100%) for use with DLVP system, 800-3000 lumens [6]

Options		Controls
EMBOD=Bodine® Emergency Module with Remote Test Switch [10] **EMBOD6ST**=Bodine® 6W Self Test Emergency Module with Remote Test Switch **EM7**=7W Emergency Module with Remote Test Switch **EM14**=14W Emergency Module with Remote Test Switch	**EMBOD7ST**=Bodine® Self Test Emergency Module with Remote Test Switch [10] **EMV7**=7W Low Voltage Emergency Module with Remote Test Switch [7] **EMV14**=14W Low Voltage Emergency Module with Remote Test Switch [7] **ETRD**=Emergency transfer device [31]	**WPST**=Factory installed Wavelinx (includes control module, sensor, cable, tilemount and ceiling mount sensor) [11] [13] **WLST**=Factory installed WaveLinx LITE Sensor Kit [11] [12] **WPN** = WaveLinx PRO Wireless Node without sensor [34]

Accessories (*Order separately*) [25]

TRM4P=White metal trim ring [26]
LGSKT4IP66=IP66 Gasket Kit
DT4RF=4 inch frosted acrylic ring [28]

PRR4=Rimless Plaster Ring [26]
RKP4=Knife Edge plaster Ring [27]

RPM4MW=Rimless Millwork Ring, Matte White [26]
RPM4MB=Rimless Millwork Ring, Matte Black [26]
RKM4MW=Knife Edge Millwork Ring, Matte White [27]
RKM4MB=Knife Edge Millwork Ring, Matte Black [27]

HSA4=Slope Adapter for 4" Aperture Housings, Specify Slope [33]

Connected Lighting Systems [6] [11]
WPST = Field installed WaveLinx sensor Kit [13]
WLST = Field installed WaveLinx LITE Sensor Kit [12]

Transformers
H347=H347 for 5500 lumens and below
H347200=347 to 120V Step Down Transformer, 200VA

Bar Hangers
HB50=C-channel Bar Hanger, 50" Long, Pair
RMB22=Wood Joist Bar Hanger, 22" Long, Pair

Notes:

1. Only product configurations with these designated prefixes are built to be compliant with the Buy American Act of 1933 (BAA) or Trade Agreements Act of 1979 (TAA), respectively. Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analysed under domestic preference requirements. Offered with spun aluminum narrow (N), medium (M) and wide (W) trims.

2. Nominal Lumens will vary depending on selected color, CRI, driver and reflector finish. Reference Multiplier tables.

3. Product is marked spacing. Reference table on page 4 for the spacing details.

5. DMX fixtures default to full on upon loss of DMX signal.

6. Not available with Chicago Plenum.

7. ULus listed only

8. Offered with
- D010, D5LT, DE010 up to 7000 lumens
- D010TR, DMX up to 4500 lumens
- DLE, DL2 up to 3500 lumens

9. Not available with 5500 lumens

10. Not available for 6500-7000 lumens

11. Refer to system specifications for additional information,features, and benefits. Order either factory installed option or accessory. Use with 0-10V driver.

12. WLST = WaveLinx LITE tilemount sensor kit for daylight dimming, PIR motion sensing, use with D010 only (Refer to WaveLinx LITE system specifications)

13. WPST = WaveLinx wireless sensor kit for daylight dimming, PIR motion sensing, and optional RLTS - Real Time Location Services, use with 0-10V only.

14. IC rated up to 3000 lumens

15. Spun aluminum only

16. PS available in self-flanged MW finish only

17. Offered up to 2000 lumens

18. Flange is the same finish as the reflector

19. Requires knife edge accessory ring

20. Anodized or spun reflectors

21. Die cast only

22. Available with narrow (N), medium (M) and medium 45 degree (MD) Spun Aluminum trims. Required for use with all IEMBOD, IEM7, IEM14,IEMV7 and IEMV14 housings. Not offered with remote driver.

23. Offered with DLVP up to 3000 lumens.

24. Black or white paint.

25. Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information.

26. Order trim with polymer trim ring (Consult specification sheet for color ordering information and options).

27. Order die cast trim with flange type 4

28. Order with self flanged trim.

29. Use only with single LED/driver.

29. If using remote driver order battery and controls with the remote driver.

30. 120V-277V

31. Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others).

32. Non-IC

33. Not recommended for use with Wall Wash

34. WPN = WaveLinx PRO wireless node provides luminaire-level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with 0-10V driver only.

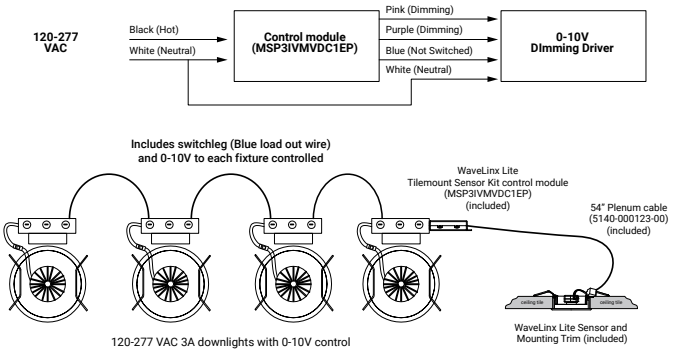
Connected Solutions

WaveLinx LITE - WLST Tilemount Sensor

- Intuitive Android™ or Apple® iOS® app for basic system code compliant set up and configuration via Bluetooth
- Up to 28 unique areas per project site (WaveLinx LITE Bluetooth network)
- Up to 50 devices for an area, any one of 16 control zones, up to 6 occupancy sets, and custom lighting scenes
- Automatic occupancy or vacancy, sensor sensitivity, daylight dimming, etc. configurable through the app
- Refer to the WaveLinx system specifications for details

Device Security | Manual Dimmer | Occupancy Sensor | Daylighting Control | Manually Switched ON/OFF | Tuning Control | Lumen Maintenance Control | Scenes

WaveLinx LITE WLST Tilemount Wiring Diagram



WaveLinx LITE Bluetooth Enabled System

WaveLinx PRO Wireless – WPST Tilemount Sensor

- WaveLinx PRO Wireless functionality configures zones and customizes settings from one secure mobile app
- Automatic code commissioning that meets the strictest codes
- Fixtures and sensors integrate with Wireless Area Controller, Wall Stations, and Control Devices
- Stand-Alone Offices or Entire Building Network Installations

Downlights with tilemount sensor wireless communication
Highly efficient LED fixtures

WaveLinx Area Controller
Provides centralized coordination of multiple area control options

Wireless Wall Station/Receptacle
Provides customized wireless control of each area

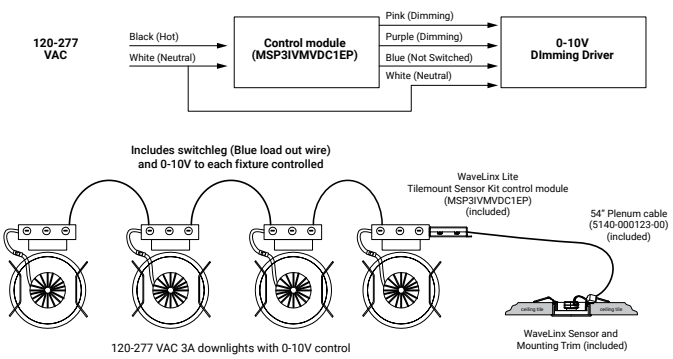
Mobile Applications
Provides personalized, local control from a tablet or smartphone

WaveLinx mobile app settings

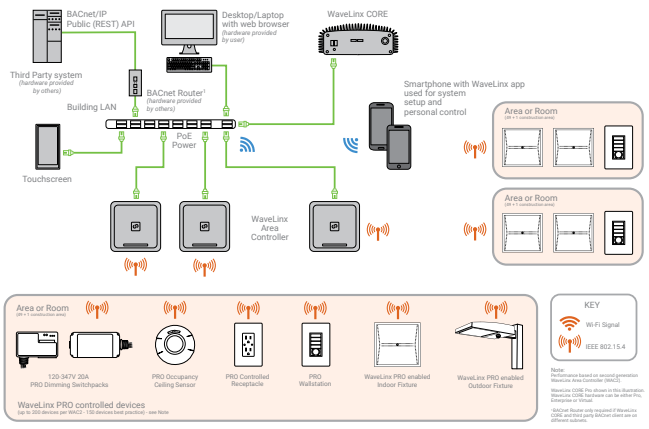
Manual Dimmer | Occupancy Sensor | Lumen Maintenance Control | Daylighting Control

Receptacle Control | Tuning Control | Scheduling | Manually Switched ON/OFF | Demand Response

WaveLinx PRO WPST Tilemount Wiring Diagram



WaveLinx CORE Building Management Integration



Connected Solutions

WaveLinx PRO Wireless Node - WPN

- WaveLinx Wireless functionality configures zones and customizes settings from one secure mobile app
- Automatic code commissioning that meets the strictest codes
- Fixtures and sensors integrate with WaveLinx Area Controller, Wall Stations, and Control Devices
- Stand-Alone Offices or Entire Building Network Installations

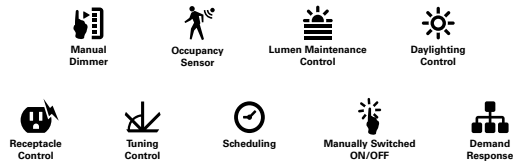
Downlights with wireless communication
Highly efficient LED fixtures

WaveLinx Area Controller
Provides centralized coordination of multiple area control options

Wireless Wall Station/Receptacle
Provides customized wireless control of each area

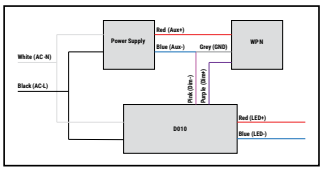
Mobile Applications
Provides personalized, local control from a tablet or smartphone

WaveLinx mobile app settings

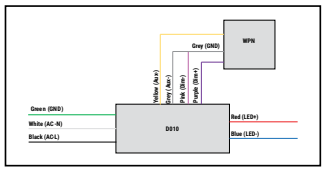


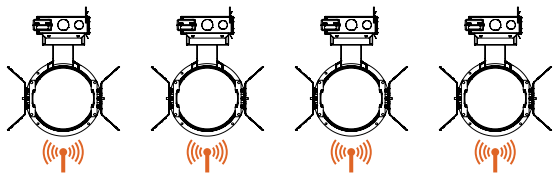
WaveLinx PRO Wireless Node (WPN) Wiring Diagram

For 0-10V drivers 250 lumens and Tunable White



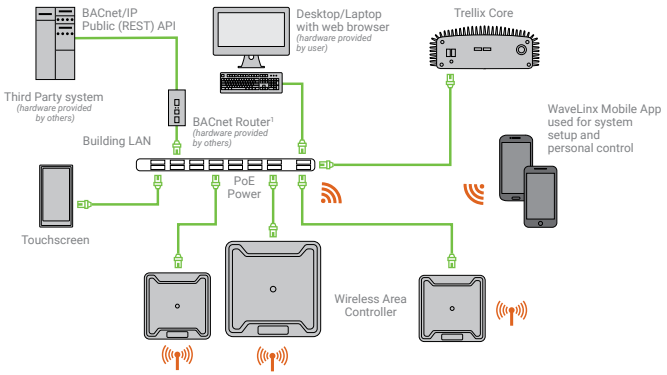
For 0-10V drivers 500 lumens and over





120-277 VAC 3A downlights with 0-10V control

WaveLinx CORE Building Management Integration



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Peachtree City, GA 30269
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www.cooperlighting.com

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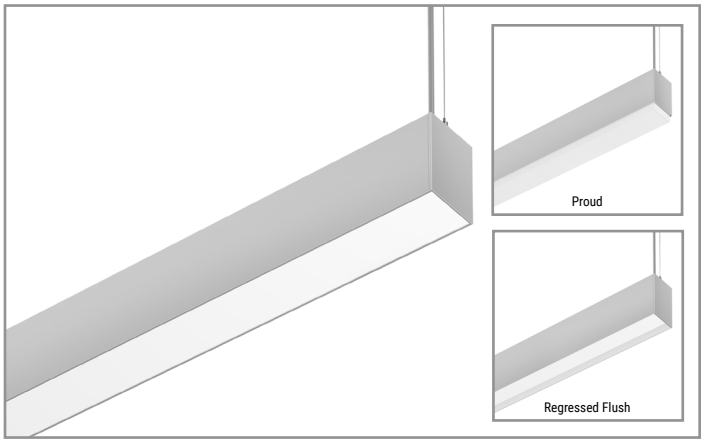
Specifications and dimensions subject to change without notice.

TYPE B

Project		**Catalog #**		**Type**	
Prepared by		**Notes**		**Date**	



Neo-Ray

Define 4

4" LED
Suspended Pendant
Direct/Indirect

Typical Applications

Office • Education • Healthcare • Hospitality • Retail

Interactive Menu

- Order Information page 2
- Product Specification page 3
- Photometric Data page 4
- Performance Data page 5
- VividTune page 6

Product Certification

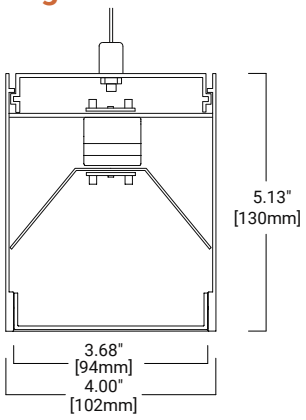
Product Features

damp location · powered by fifthlight · VividTune · QS

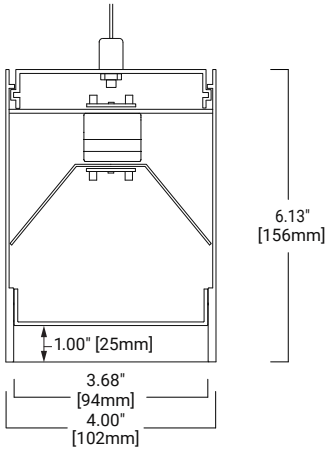
Top Product Features

- Suspended Slot family in 2", 3", 4" and 5" housing sizes
- Specifiable to the nearest foot
- Satin, Asymmetric and Drop Direct Lensing available
- Independently specifiable Direct / Indirect lumen packages
- 0-10V dimming standard; DALI dimming available
- 2700K, 3000K, 3500K, 4000K, and 5000K correlated color temperatures available
- Options to meet Buy American Act requirements

Dimensional and Mounting Details



Standard Housing



Regressed Housing

additional product diagrams

Order Information

Icon Key: Grey bar denotes available with 10-Day Quick Ship
Ø Consult factory for availability

SAMPLE ORDER NUMBER: **S124DIP-C795D365U835-C4JB4F0-1T-UDD-F1-W-WAA**

Domestic Preference	Series	Light Engine	Lumen Package Down (Lms/ft)	Lumen Package Up (Lms/ft)	CRI	LED CCT	Suspension Type	Ceiling Type	Mounting HW Color
[Blank]=Standard **BAA**=Buy American Act	**QS-S124DIP**=Define 4 Direct/Indirect Pendant Quick Ship **S124DIP**=Define 4 Direct/Indirect Pendant **S124RDIP**=Define 4 Regressed Direct/ Indirect Pendant	**-C**=Core **-H**=High Performance **-V**=VividTune Ø	**350D**=350 Lms/ft (2.9W/ft) **575D**=575 Lms/ft (4.8W/ft) **795D**=795 Lms/ft (6.7W/ft) **1020D**=1020 Lms/ft (8.8W/ft) **1195D**=1195 Lms/ft (10.6W) **____D**=Custom Lms/ft Ø	**365U**=365 Lms/ft (2.2W/ft) **590U**=590 Lms/ft (3.6W/ft) **810U**=810 Lms/ft (5.0W/ft) **1035U**=1035 Lms/ft (6.6W/ft) **1205U**=1205 Lms/ft (7.9W) **____U**=Custom Lms/ft Ø	**8**=80 **9**=90	**27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K **2765**=2700K-6500K **3050**=3000K-5000K	**-C4**=4ft Aircraft Cable **-C10**=10ft Aircraft Cable **-C20**=20ft Aircraft Cable **-S4**=4ft Stem Mount **-S8**=8ft Stem Mount	**JB**=Gypsum Board, Junction Box, Structure **T1**=15/16" T-Grid (ETG) **T9**=9/16" T-Grid (FTG) **TS**=9/16" Slot (STG), Tegular (FTT), Interlude (ITG)	**(blank)**=White **B**=Black
Notes Only product configurations with this designated prefix are built to be compliant with the Buy American Act of 1933 (BAA). Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.	**Notes** RDIP regress of 1" will add an additional 1" to fixture depth.	**Notes** See performance table for add'l details. Light engine must be consistent across run length. V option requires lumen package of 795 lms/ft or greater and fixture length of 3 ft+.	**Notes** 3500K/80CRI/DIP/F Lens. Please refer to scaling data for other variables. For custom lumen output, please refer to additional information on page 3. 1195 Lms/ft not valid with DALI or Lutron Drivers. 350 Lms/ft available on fixture length 4ft+.	**Notes** 3500K/80CRI/No Lens. Please refer to scaling data for other variables. For custom lumen output, please refer to additional information on page 3	**Notes** Additional lead-time and cost may apply for 850, 927, 930, 935, 940 and 950 configurations. 2765/3050 VividTune configurations require V light engine and W2A driver.		**Notes**	**Notes**	**Notes** White mounting hardware standard

Luminaire Length (Ft)	Max section length	Circuiting	Additional Section Wiring	Voltage	Driver Type	Shielding Down
3**F0**= 3' Nominal Length 4**F0**= 4' Nominal Length 8**F0**=8' Nominal Length **___F0**=4' Incremental Run (e.g. 40F0 = 40' 0") **___F0**=1' Incremental Run (e.g. 39F0 = 39' 0")	**(blank)**=12ft (std) **/8**=8ft	**-1**=Single Circuit **-2**=Dual Circuit **-S**=Secondary Circuit	**E**=Emergency Circuit **B1**=Surelite 7W 120-277V EM battery pack (EL7W) **B2**=Surelite 14W 120-277V EM battery pack (EL14W) **B3**=Bodine 6W UNV Integral **T**=UL924 EPC Emergency Bypass Relay	**-U**=Universal (120V-277V) **-1**=120V **-2**=277V **-3**=347V	**DD**=Standard 0-10V Dimming (1%-100%) **5L**=Fifth Light DALI (5%-100%) **L5**=Lutron 5 Series (LDE5) 5%-100% EcoSys **LH**=Lutron HiLume (LDE1) 1%-100% EcoSys **W2A**=White Tuning, 0-10V Dimming (VividTune only)	**-F**=Satin White Diffuser **-D**=Satin Drop diffuser **-A**=Asymmetric Diffuser **-L**=Straight Blade Diffuser w/ diffuser
Notes Minimum fixture length is 3ft. Specify to nearest foot in length.	**Notes** Individual fixtures configured as 12ft max by default. Continuous runs configured as 8ft max (12ft not available).	**Notes** Dual circuit will provide separate Up/Down control. Secondary circuit similar to A/B switching. Price adder applies for "S" configuration.	**Notes** Battery available on fixture ≥ 4ft in length. B1-B3 and T options not compatible with 347V. Standard battery 4ft battery section located in the beginning of the fixture, but can be relocated using the linear product configurator.	**Notes** 347V only available with DD driver options.	**Notes** DD driver is standard. For non-dimming applications, the driver will default to full brightness if no connection is made to the capped dimming wires in the field.	**Notes** All lensing options are snap-in lenses. "L" option required RDIP series and will require additional lead-time, please consult factory for details.

Shielding Up	Options	Finish	Integrated Sensor
(blank)=No Lens or N/A **1**=Satin White Diffuser **4**=Widespread Batwing Optic	**-R**=GLR Fuse (Fast) **-F**=GMF Fuse (Slow)	**-W**=White **-S**=Silver **-B**=Black **-C**=Custom Match **-R**=RAL Custom	**-WAA**=WaveLinx Pro Wireless **-WAB**=WaveLinx Lite Wireless Ø **-LWIPD1**=Enlighted Wireless **-SVPD1**=Standalone **(Blank)**=None
Notes No lens up standard, use satin white diffuser when dust cover desired of top of the fixture is viewable during normal use. Batwing option requires "-C" light engine.	**Notes** Additional lead-time may apply. Not available with 347V option.	**Notes** Contact factory for C and R options. W/S/B are standard.	**Notes** DD driver must be selected. Please refer to page 5 for additional detail required to specify integrated sensors. Integral option not available with regressed or drop lensing. Battery not compatible with integrated sensor in 4ft DIP fixture.

Product Specifications

Construction
- Available in Flush and Regressed Housing
- Precision cut housing extruded from 6063 aluminum
- Precision cut & welded end-caps ensure a robust and clean construction
- Nominal 2' -12' illuminated sections used in individual fixtures and 2'-8' illuminated sections used in continuous runs

Finish
- Electrostatically applied polyester powder coat paint

LED Module
- Modular LED tray assembly comprising reflector and light engine with quick disconnect wire-harness for ease of installation and maintenance over the life of the luminaire

Light Engine
- Offered with two next generation Neo-Ray light engines delivering industry leading efficacy and long-life
- LED's are available in 2700K, 3000K, 3500K, 4000K or 5000K
- CRI options of either ≥80CRI or ≥90CRI (Lumen output will be affected - please refer to the lumen adjustment factor table)

LED Drivers
- LED system coupled with electrical driver
- Traditional electronic drivers are available for 120-277V and 347V applications

Controls and Integrated Sensors
- Equipped standard with a 0-10V continuous dimming driver. Compatible with most standard dimming devices
- Additional control types are available (DALI & Lutron) at an additional cost
- WaveLinx and Enlighted wireless sensors as well as stand-alone sensors available

Mounting
- Suspended

Lengths
- Available in any length (2ft min) with a resolution of 1 foot. Max section length of 12ft (8ft max used on continuous runs and available for individual fixtures)
- Additional fixture lengths are available please consult factory. All lengths are nominal and do not include end caps.

Corners and Transition Pieces
- Corners and other transition pieces are fully luminous
- Constructed using precision mitered housing and lens components
- Extrusions are welded to ensure a precise and robust assembly
- Standard 90° horizontal corners as well as custom corners are available
- Consult online linear configurator or the factory for precise corner locations and for ordering
- Alternative transition pieces such as T's, Y's, X's, etc. are also available Ø

Direct Snap-In lensing Options
- Satin Flush - Flush, high diffusion glare-free lens
- Satin Drop - 1" Drop, high diffusion glare-free lens
- Asymmetric - Flush, low-glare Asymmetric lens
- Flush options ship with our patent-pending underlens solution, the proud lens ships with an injection molded end cap to eliminate light leak

Indirect Snap-In lensing Options
- Satin Flush - Flush, high diffusion glare-free lens
- No Lens - No lens option provides the lowest cost solution with the highest efficacy

Reflectors
- Precision formed cold-rolled steel reflectors with high reflectivity
- Ultra high reflectivity used with High Performance light engine

Lumen Maintenance
- 90% (L90) of initial light output at 61,000+ hrs
- 70% (L70) of initial light output at 237,000+ hrs
- Derived from TM-21 standard @25°C for worst case operating conditions

Custom Lumen Output
- Custom lumen output expressed option in Lumens per foot (e.g. -725D for 725 Lms/ft down). Refer to additional detail on page 4.

Electrical
- Dimming provided as standard
- Dimming wires capped with wire-nuts for non-dimming applications
- Optional battery backup options provided
- Default battery location is internal to fixture
- Default emergency section is 4ft in length and located at the beginning of the fixture unless designated elsewhere
- Estimated lumen output = battery wattage * min efficacy (see performance table)
- The EPC option will bypass local controls and dimming upon loss of normal power. This option is required when the fixture has both integrated sensors and emergency circuiting

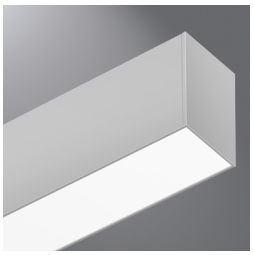
Integrated Sensors
- Please reference page 5 for details

Weight
- 4.2 lbs per foot

Approvals
- cULus - listed for damp locations
- Meets NYC requirements
- Meets CCEC requirements
- Tested to IESNA LM-79 and LM-80
- Can be used for State of California Title 24 high efficacy luminaire

Warranty
- Five year warranty standard.

Shielding Options



Standard Flush Lens

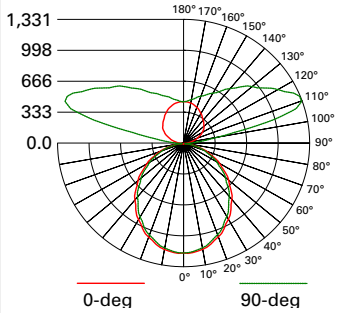
Regressed Flush Lens

Standard Proud Lens

Asymmetric Lens

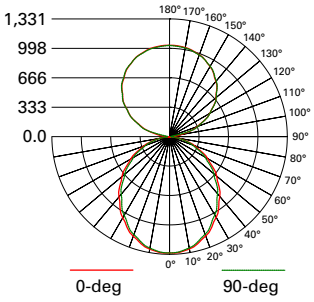
Photometric Data

View IES files

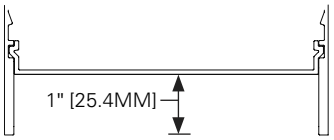


FILE NAME:
S122DIP-S675D725U835-4F0-1E-UDD-F4
LUMENS: 6303.3 Lms
LPW: 137.3 LPW
CCT: 3500K
WATTS: 45.9 W
TEST NUMBER: P332606

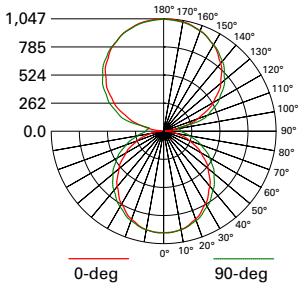
SATIN FLUSH LENS



FILE NAME:
S124DIP-S795D795U835-4F0-1E-UDD-F
LUMENS: 6643.2 Lms
LPW: 144.7 LPW
CCT: 3500K
WATTS: 45.9 W
TEST NUMBER: P332604

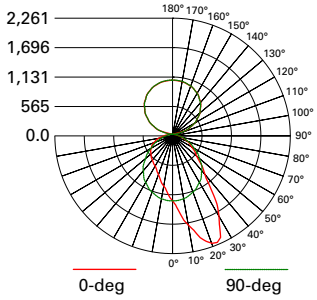


SATIN REGRESSED DIFFUSER



FILE NAME:
S124DIP-S795D795U835-4F0-1E-UDD-D
LUMENS: 6474.7 Lms
LPW: 141.1 LPW
CCT: 3500K
WATTS: 45.9 W
TEST NUMBER: P332601

SATIN DROP LENS



FILE NAME:
S124DIP-S795D795U835-4F0-1E-UDD-A
LUMENS: 6778.9 Lms
LPW: 147.7 LPW
CCT: 3500K
WATTS: 45.9 W
TEST NUMBER: P332598

ASYMMETRIC FLUSH LENS

Photometric Overview and Performance Data

Direct Performance Per Linear Foot at 3500K/80CRI

Nominal Output	Standard		High Performance		VividTune	
lms/ft	W/ft	lm/W	W/ft	lm/W	W/ft	lm/W
350	2.9	133	2.9	136	3	129
575	4.8	134	4.4	140	4.9	130
795	6.7	131	6.1	141	6.7	128
1020	8.8	129	8.1	137	8.9	125
1195	10.6	124	9.7	132	10.7	121

Indirect Performance Per Linear Foot at 3500K/80CRI

Nominal Output	Standard		High Performance		VividTune	
lms/ft	W/ft	lm/W	W/ft	lm/W	W/ft	lm/W
365	2.2	168	2.5	171	2.6	164
590	3.6	169	3.9	176	4.3	158
810	5.0	165	5.3	177	5.9	158
1035	6.6	161	7.1	168	7.8	154
1205	7.9	157	8.5	164	9.4	153

LUMEN ADJUSTMENT CALCULATIONS

Example 1 - Adjusted Lumen Output
Nominal Lumen Output selected = 1025 lms/ft (based on standard of 3500K/80CRI)
Lumen Adjustment Factor = 0.801 (2700K/90CRI desired)

Adjusted Lumen Output = Nominal Lumen Output x Lumen Adjustment Factor
Adjusted Lumen Output = 1025 lms/ft x 0.801 = 821 lms/ft

Example 2 - Custom Lumen Output based on Required Lumens Per Foot
Total light output (4ft) requirement of 2800 lms, desired CCT and CRI of 4000K/80CRI

Total required lumens per foot @ 4000K= 2800 lms / 4 ft = 700 lms/ft
Lumen Adjustment Factor = 1.018 (Requirement based on 4000K / 80CRI)

Total required lumens per foot @ 3500K / 80CRI = 700 lms/ft ÷ 1.018 = 688 lms/ft

Estimated efficacy = 121 LPW (find nearest value using table above)
Estimated power consumption = 688 lms/ft ÷ 121 lm/W = 5.69 W/ft

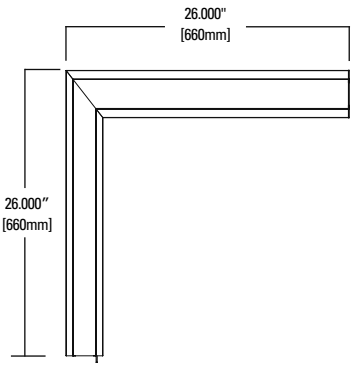
Custom Lumen Output

Total Light Output Range (lms/ft)

CCT	Lumen Adj Factors		Direct Output Range		Indirect Output Range	
	80CRI	90CRI	80CRI	90CRI	80CRI	90CRI
2700K	N/A	0.792	N/A	277-946	N/A	289-954
3000K	0.943	0.815	330-1127	285-974	344-1136	297-982
3500K	1.000	0.861	350-1195	301-1029	365-1205	314-1038
4000K	1.010	0.892	354-1207	312-1066	369-1217	326-1075
5000K	1.010	0.892	354-1207	312-1066	369-1217	326-1075

If your requirement is expressed in power consumption (W/ft) rather than light output, you can use the power to lumen output curves to convert power consumption to light output for specification. Efficacy for custom lumen outputs can be estimated using lumen output curves or with the use of our online custom lumen output tool.

Corner Transitions



Integrated Sensor Details and Placement

Sensor Type	Wireless	Sensor Integration	Sensor Mounting	Ordering Code
WaveLinx Pro	Yes	Integral to Fixture	Mounted in solid cover	WAA
WaveLinx Lite	Yes	Integral to Fixture	Mounted in solid cover	WAB
Enlighted	Yes	Integral to Fixture	Mounted in illuminated lens	LWIPD1
Stand-Alone	No	Integral to Fixture	Mounted in solid cover	SVPD1

Optional standalone and wireless connected integrated sensors require use of the DD (0-10V) driver. WaveLinx and Enlighted sensors require additional system hardware (not provided) for full functionality.

Standard sensor layout is shown below. Please refer to sensor coverage pattern diagrams to ensure proper coverage for the application. Standard configurations are available in both individual fixtures and in continuous runs. Default spacing is based on the maximum fixture length of 12ft and can be changed to 8ft sensor spacing for additional coverage by selecting the 8ft max fixture length option when ordering.

For additional information integrated sensors and connected lighting, please visit CooperLighting Solutions's Connected Lighting Website.

○ Standard Sensor with Luminaire Control
⊗ Auxiliary Sensor used for Sensor Coverage (wireless systems only)

INTEGRAL SENSOR

≤8ft Individual ○

>8ft Individual ○ ⊗

Note: When 8ft max section length is used on individual fixtures > 8ft, sensor placement follows logic for continuous run.

Beginning of Run (BOR) ○

Intermediate Section (INT) ○

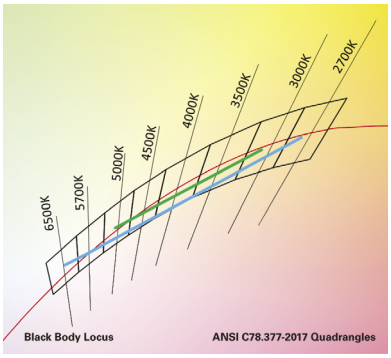
End of Run (EOR) > 4ft ○ ⊗

End of Run (EOR) ≤ 4ft ○

VividTune™
color tuning solutions

Define 4 Pendant LED with VividTune Tunable White

VividTune tunable white luminaires deliver high-quality light in a broad range of continuously variable color temperatures and intensities. Create a dynamic environment by adjusting the ambient light warmer or cooler to influence mood, support the task at hand, or create a dramatic ambience. The ability to control correlated color temperature and intensity separately using simple controls is the next evolution of LED lighting for the commercial, educational, healthcare and hospitality space. The unparalleled flexibility and number of available lighting environments enable users to find the right light with tunable white.



Performance Data*

Tunable White - Lumen Adjustment Factors

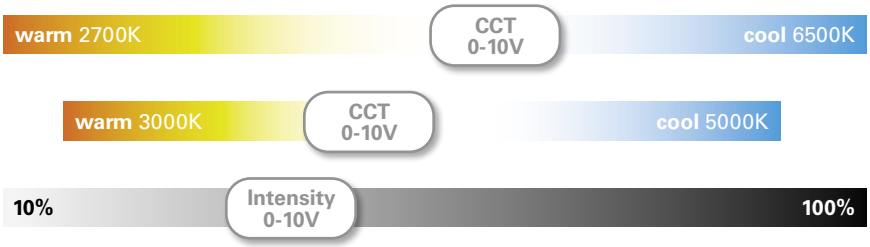
CCT	3000K-5000K		2700K-6500K	
	80 CRI	90 CRI	80 CRI	90 CRI
2700K	-	-	0.868	0.741
3000K	0.894	0.736	0.893	0.771
3500K	0.946	0.804	0.924	0.809
4000K	0.993	0.868	0.944	0.835
4500K	1.002	0.883	0.961	0.857
5000K	1.002	0.883	0.974	0.874
6500K	-	-	0.988	0.897

Example of Approximate Lumen Calculation

CCT Setting	Standard Catalog #	VividTune 80 CRI Catalog #	VividTune 90 CRI Catalog #
	S124DIP-C1020D1035U835-X-UDD-F-W	S124DIP-V1020D1035U83050-X-UW2A-F-W	S124DIP-V1020D1035U93050-X-UW2A-F-W
3000K	-	7349	6050
3500K	8220	7776	6609
4000K	-	8162	7135
4500K	-	8236	7258
5000K	-	8236	7258

Controlling VividTune Tunable White

VividTune luminaires make tunable white more accessible by using simple and familiar controls. From wall dimmers to wireless controls, VividTune tunable white luminaires are compatible with industry standard 0-10V dimming controls. A single 0-10V dimming input is used to control intensity (brightness) while a second 0-10V dimming input is used to adjust CCT. For suggested control configurations, go to www.cooperlightingsolutions.com for tunable white application guides.



Example of Lumen Adjustment Calculation

S124DIP-V1020D1035U83050-X-UW2A-F-W
at 80 CRI tuned to 3500K

Adjusted Lumen =
published lm x adjusted lm factor

Adjusted Lumen = 8220 x 0.946

Adjusted Lumen = 7776 lm

** Lumen adjustment factors are for reference and may be different for each product selected. Refer to IES files for actual performance data on each.*

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Specifications and dimensions subject to change without notice.

TYPE C

Project		**Catalog #**		**Type**	
Prepared by		**Notes**		**Date**	

Metalux

Cruze ST 24CZ2

2' x 4' LED Specification Grade Troffer

Typical Applications

Office • Education • Healthcare • Hospitality • Retail

Interactive Menu

- Order Information page 2
- Photometric Data page 3
- Connected Systems page 5
- VividTune™ Color Tuning Solutions page 6
- Product Warranty

Product Certification

Product Features

Connected Systems · Bluetooth · damp location · VividTune · BAA

LINEAR DISCONNECT — Designed to provide safe and convenient means of disconnecting power

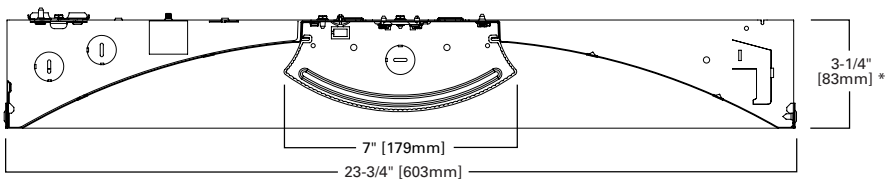
MWS MODULAR WIRING SYSTEM CLICK HERE

Rapid Response CLICK HERE

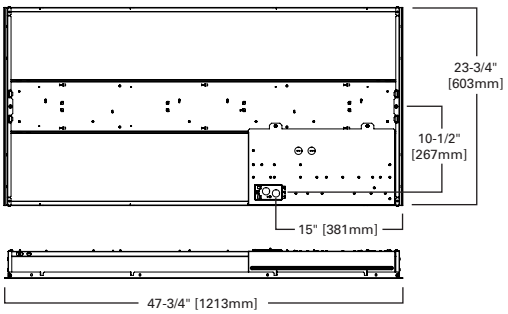
Top Product Features

- Latch-less design provides clean architectural look
- VividTune CCT tuning options from 3000K-5000K or 2700K-6500K
- Designers delight - ribbed, smooth and round perforated lens options
- High performance efficacy up to 167 lm/W
- Integrated sensor systems - occupancy, daylight and IoT connectivity
- Options to meet Buy American and other domestic preference requirements

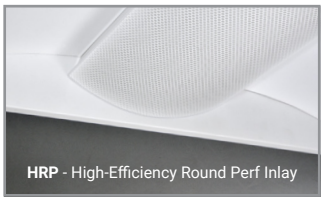
Dimensional and Mounting Details



*When combined with emergency total height is increased by 1 inch.



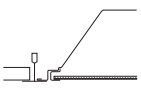
Shielding



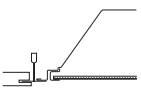
See ordering information for more shielding options.

Ceiling Compatibility

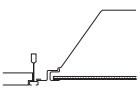
G Grid/Lay-in Standard



G Concealed T



G Slot Grid



Ceiling Type	Trim Type
Exposed Grid	Standard
Concealed T	Standard
Slot Grid	Standard
Flange	*

*See Drywall Frame Kit Accessory in Ordering Information Section

Order Information

SAMPLE ORDER NUMBER: **24CZ2-45HE-UNV-L835-CD1-U**

Domestic Preferences / Rating / Series / Air / Lumen Output / Shielding / Voltage

Domestic Preferences [1]	Rating	Series	Air	Lumen Level	Efficacy	Shielding	Voltage [9]
[Blank]=Standard **BAA**=Buy American Act **TAA**=Trade Agreements Act	**[Blank]**=Standard **ATW-SW4**= Chicago Rated	**24CZ2**=2x4 Cruze ST	**[Blank]**=Standard **A**=Air (Vented) [2]	**30**=3000 Lumens **35**=3500 Lumens **40**=4000 Lumens **45**=4500 Lumens **50**=5000 Lumens **55**=5500 Lumens [3] **60**=6000 Lumens [3] **65**=6500 Lumens [3], [4] **70**=7000 Lumens **75**=7500 Lumens [4] **80**=8000 Lumens [4] **85**=8500 Lumens [4] **90**=9000 Lumens [4] **95**=9500 Lumens [4] **100**=10000 Lumens [4] **110**=11000 Lumens [4] **120**=12000 Lumens [4] **130**=13000 Lumens [4] **150**=15000 Lumens [4] **170**=17000 Lumens [4]	**[Blank]**=Standard Efficacy [6] **HE**=High Efficacy [7] **VHE**=Very High Efficacy [4], [8]	**[Blank]**=Ribbed Frosted Acrylic Lens (standard) **S**=Smooth Frosted Acrylic Lens **HRP**=High-Efficiency Round Perf Inlay **SQR**=Square Ribbed Frosted Acrylic Lens	**UNV**=Universal Voltage 120-277 **347V**=347 Volt [10] **48V**=48 Volt Low-voltage (Class 2) [C]

Notes

(1) Only product configurations with these designated prefixes are built to be compliant with the Buy American Act of 1933 (BAA) or Trade Agreements Act of 1979 (TAA), respectively. Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.

Notes

(2) Air version is intended for air return through plenum. See air return data table for air flow volumes. Air option not available with ATW-SW4. Air requires "PAF" option.

Notes

(3) Not available with white tuning and Standard Efficacy. (4) Available with CD or HCD drivers only. (6) Available up to 6500 lumens. (7) Available up to 7500 lumens. (8) Requires 2 CD-1 drivers above 100VHE.

Notes

(9) Products also available in non-US voltages and frequencies for international markets. (10) Some 347V versions require a transformer. Total wattage will increase by 2 watts if used. (C) Consult WaveLinx Low-Voltage or DLVP system pages for additional details and compatibility.

Options / Emergency Options / CRI/CCT / Flex

Options	Emergency Options	CRI/CCT	Flex
GL=Single Element Fuse **GM**=Double Element Fuse **PAF**= Painted After Fabrication	**[Blank]**=No emergency **EL7W**=7-watt 120V-277V emergency battery pack [11] **EL10W**=10-watt 120V-277V emergency battery pack [11] **EL14W**=14-watt 120V-277V emergency battery pack [11] **EL10WSD**=10W emergency battery pack with self-diagnostic installed [11], [13] **EL14WSD**=14W emergency battery pack with self-diagnostic installed [11], [13] **ELV7W**=Low-voltage system, 7-watt emergency battery pack [C] **ELV14W**=Low-voltage system, 14-watt emergency battery pack [C] **ETRD**=Emergency Transfer Relay with dimming control [12] **RRU**=LVS Controls Emergency Transfer Relay with dimming control [12] **UEL7W**=UL924 Listed luminaire, 7-watt, 120V-277V emergency battery pack [11] **UEL14W**=UL924 Listed luminaire, 14-watt 120V-277V emergency battery pack [11] **UEL10WSD**=Bodine 10W emergency battery pack with self diagnostic installed [11], [14] **UETRD**=UL924 Listed luminaire, Emergency Transfer Relay with dimming control [12] **URRU**=UL924 Listed luminaire, LVS Controls Emergency Transfer Relay with dimming control [12]	**L830**=80CRI, 3000K **L835**=80CRI, 3500K **L840**=80CRI, 4000K **L850**=80CRI, 5000K **L930**=90CRI, 3000K **L935**=90CRI, 3500K **L940**=90CRI, 4000K **L950**=90CRI, 5000K **L83050**=80CRI 3000K-5000K White Tuning [15] **L93050**=90CRI 3000K-5000K White Tuning [15] **L82765**=80CRI 2700K-6500K White Tuning [15] **L92765**=90CRI 2700K-6500K White Tuning [15]	**[Blank]**=No Flex **A3/8-4/18GDIM**=3/8" Flex with 0-10V Dimming Leads **A3/8-2/18G**=3/8" Flex with line and common **A3/8-5/18GDIM**=Flex with 0-10V Dimming leads and Blue for alternate wiring. See below for details.

Notes

(11) Factory installed with integral test switch/indicator/laser test. For approximate delivered lumens multiply the lumens per watt of the desired fixture by the wattage of the emergency battery pack (100 lm/W x 7=700 lumens). IES-format photometry for luminaire under emergency operation available. Battery option increases total height by 1 inch. (12) Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others). Devices are universal voltage (UNV). 347 not available. (13) EL10WSD and EL14WSD not available with 347V. (14) UEL10WSD not available with 347V. (C) Consult WaveLinx Low-Voltage or DLVP system pages for additional details and compatibility.

Notes

(15) White tuning provides correlated color temperatures (CCT) between 3000K (warm) to 5000K (cool) or 2700K (warm) to 6500K (cool). Must be used in conjunction with W2A driver only. Must be used with two (2) 10V dimming control channels, 1 color, 1 intensity. May be combined with Wavelinx sensor control systems only.

Flexible Metal Conduit Options

Flex options available for 0-10V dimming control, DALI dimming control, emergency and night light functions. 72-inch factory-installed and pre-wired to driver, fitted to luminaire housing access plate with 90° enclosed FMC connector. Not all options may be combined and installation ratings vary by type. See online configurator for all flex options.

A3/8-4/18GDIM series notes: Factory installed dimming option 3/8" flexible metal conduit with 2-#18 power and ground wires and 2-#18 UL-listed jacketed 0-10V +/- control wires. Meets UL 66, 83, 1479, 1569, 1581, 2556. NEC® 250.118, 300.22(C), 392, 396, 330, 501, 502, 503, 530, 504, 505, 518, 520, 530, 645, 72; Federal Specification A-A-59544 (formerly J-C-30B); all applicable OSHA and HUD Requirements. UL Classified 1-, 2-, and 3-hour through penetration with applicable fire stop product (not included). May be surface mounted, fished and/or embedded in plaster. Cable tray and approved raceway rated, install per NEC®; Environmental Air-Handling Space Installation per NEC® 300.22(C).

Driver Type / Number of Drivers / Integrated Sensing Systems / Packaging

Driver Type	Number of Drivers	Integrated Sensing Systems [18]	Packaging
CD=0-10V Driver (10%-100% Dimming) **HCD**=0-10V Driver (1%-100% Dimming) **5LTD**=DALI Driver (5%-100% Dimming) **5LTHD**=DALI Driver (1%-100% Dimming) **LV**=Low-voltage System Driver (0%-100% Dimming) [C] **SD**=Step Dimming Driver (50%-100% Dimming) **LH**=Lutron HiLume (LDE1 series) 1%-100% EcoSystem Driver with Soft-on Fade to Black dimming [F] **W2A**=White Tuning, 2 ch, Analog 0-10V Intensity and CCT Control [16] **SR**=Sensor-ready Driver (1%-100% Dimming)	**1**=1 Driver **2**=2 Drivers [17]	**[Blank]**=No Sensor **WAA**=WaveLinx PRO Wireless Integrated Sensor [19], [A] **WPN**=WaveLinx PRO Wireless Node without Sensor [19], [A] **WAB**=WaveLinx LITE Wireless Integrated Sensor [20], [B] **WLA**=Low-voltage Integrated Sensor [21], [C]	**U**=Unit Pack **PAL**=Job Pack, out of carton **PALC**=Job Pack, in carton

Notes

(16) White tuning provides correlated color temperatures (CCT) between 3000K (warm) to 5000K (cool) or 2700K (warm) to 6500K (cool). Must be used in conjunction with W2A driver only. Must be used with two (2) 10V dimming control channels, 1 color, 1 intensity. May be combined with Wavelinx sensor control systems only.

Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (C) Consult WaveLinx Low-Voltage or DLVP system pages for additional details and compatibility. (F) Consult Marketplace Options - Lutron system pages for additional details and compatibility. Compatible only with driver series shown, and may require two or more drivers. Requires field commissioning to operate or dim. Contact Lutron at www.lutron.com.

Notes

(17) See lumen limitation notes for applications requiring 2 drivers or use online configurator. When combined with emergency total height is increased by 1 inch.

Notes

(18) Matching width lens band on other side of sensor band may be supplied for symmetrical appearance. Required for use with sensor and emergency combination. Add "D" to sensor ordering as shown - WAAD, WABD. (19) WAA sensor and WPN node to be used with CD, HCD or W2A driver. Consult factory for WPN with tunable white W2A driver. (20) WAB sensor to be used with CD or HCD driver. (21) WLA sensor to be used with LV driver.

Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (A) Consult WaveLinx PRO system pages for additional details and compatibility. (B) WaveLinx LITE devices are not currently compatible with the WaveLinx Wireless Area Controller. Consult WaveLinx LITE system pages for additional details and compatibility. (C) Consult WaveLinx Low-Voltage or DLVP system pages for additional details and compatibility.

Accessories

Accessories (order separately) [24]
CZ2-EQCLIP-U-PK="CZ2" Earthquake Clip Kit (4 clips per bag kit) [23] **DF-24W-U**=2' x 4' Drywall Frame Kit **SK-24-WS**=2' x 4' Shallow Surface Mount Kit **SK-24-WT**=2' x 4' Tall Surface Mount Kit

Notes

(23) An EQ Grid Clip is recommended for all 9/16" ceiling systems. Four required per fixture.
(24) Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information. Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories.

Product Specifications

Construction
- Die formed of code gauge prime cold rolled steel with full length die-formed stiffeners
- Unibody endplates attached with interlocking tabs and screws
- Hemmed side flanges
- Four auxiliary fixture end suspension points
- Integral Grid-lock feature for endplates for added safety
- Optional earthquake clips available

Integrated Controls
- Standard with 0-10V dimming driver (10% standard, 1% optional)
- WaveLinx wireless sensor compatible for standalone, controlled, connected, and IoT capability
- Low-voltage sensor and driver compatible for WaveLinx Low-Voltage and DLVP applications
- DALI 2.0, Lutron, and step-dimming available

LED and Light Engine
- LED's available in 3000K, 3500K, 4000K, or 5000K at 80 CRI minimum and 90 CRI minimum
- Color accuracy ≤3-Step MacAdam ellipse (SDCM)
- TM21 life at 60,000 hours up to L90 and calculated L70 exceeds 203,000 hrs.
- Drivers available in 120-277V and 347V
- Tunable white options available with Cooper Lighting Solutions' Vividtune

Emergency Options
- 120V-277V integral emergency battery pack comes in 7-watts, 10-watt, or 14-watts
- Self-diagnostic emergency battery available in 10 or watts (NFPA 101® Life Safety Code®)
- Constant power to the LED system for controlled, predictable discharge
- Integrated test switch/indicator light visible from floor
- Min. 90-minute backup period for code compliance
- Integral emergency transfer relay available for generator equipped power systems

Shielding
- Ribbed acrylic frosted lens standard
- Optional smooth acrylic frosted lens (S)
- Optional square ribbed frosted acrylic lens (SQR)
- Optional High-Efficiency Round Perf Inlay (HRP)
- Replacement lenses available, contact factory

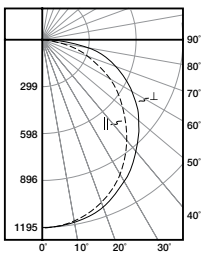
Compliance
- IC rated for insulation contact
- cULus listed for damp locations
- UL924 luminaire listing available, see Emergency Options
- RoHS compliant
- Tested to IESNA LM-79 and LM-80
- Stated life tested to TM21 standards
- Can be used for State of California Title 24 high efficacy luminaire

Warranty
- Five-year warranty standard. Optional ten year warranty available.

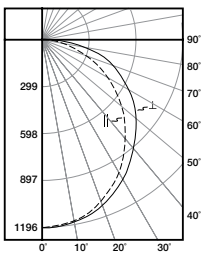
Finish
- Multistage, iron phosphate pretreatment
- 90% reflective, matte white enamel finish
- Full fixture housing pre-painted matte white (choose PAF option for "Paint after Fabrication")

Photometric Data

View IES files



24CZ2-35-UNV-L830-CD1-U
Dimming Driver
Linear LED 3000K
Spacing criterion: (II) 1.22 x mounting height, (⊥) 1.28 x mounting height
Lumens: 3618
Input Watts: 30.1W
Efficacy: 120.2 LPW
Test Report: 24CZ2-35-UNV-L830-CD1-U.IES



24CZ2-35HE-UNV-L830-CD1-U
Dimming Driver
Linear LED 3000K
Spacing criterion: (II) 1.21 x mounting height, (⊥) 1.27 x mounting height
Lumens: 3562
Input Watts: 26.9W
Efficacy: 132.4 LPW
Test Report: 24CZ2-35HE-UNV-L830-CD1-U.IES

Energy and Performance Data

Standard Efficacy Versions – Single Row of LEDs
Default CCT/Lumen Setting: 3500K/Med

Catalog Number	Lumens	Watts	lm/W
24CZ2-30-UNV-L835-CD1-U	3028	22.4	135
24CZ2-35-UNV-L835-CD1-U	3633	27.3	133
24CZ2-40-UNV-L835-CD1-U	4178	30.4	137
24CZ2-45-UNV-L835-CD1-U	4602	35.0	132
24CZ2-50-UNV-L835-CD1-U	5049	39.6	128
24CZ2-55-UNV-L835-CD1-U	5571	41.1	135
24CZ2-60-UNV-L835-CD1-U	6056	46.3	131
24CZ2-65-UNV-L835-CD1-U	6601	50.1	132

High Efficacy Versions – Two Rows of LEDs
Default CCT/Lumen Setting: 3500K/Med

Catalog Number	Lumens	Watts	lm/W
24CZ2-30HE-UNV-L835-CD1-U	3100	22.3	139
24CZ2-35HE-UNV-L835-CD1-U	3685	27.0	137
24CZ2-40HE-UNV-L835-CD1-U	4144	30.7	135
24CZ2-45HE-UNV-L835-CD1-U	4712	35.3	134
24CZ2-50HE-UNV-L835-CD1-U	5164	38.6	134
24CZ2-55HE-UNV-L835-CD1-U	5722	43.5	132
24CZ2-60HE-UNV-L835-CD1-U	6182	44.1	140
24CZ2-65HE-UNV-L835-CD1-U	6777	48.9	139
24CZ2-70HE-UNV-L835-CD1-U	7218	49.3	146
24CZ2-75HE-UNV-L835-CD1-U	7787	55.4	141

Very High Efficacy Versions – Three Rows of LEDs
Default CCT/Lumen Setting: 3500K/Med

Catalog Number	Lumens	Watts	lm/W
24CZ2-30VHE-UNV-L835-CD1-U	3011	20.4	148
24CZ2-35VHE-UNV-L835-CD1-U	3526	22.8	155
24CZ2-40VHE-UNV-L835-CD1-U	4042	26.2	154
24CZ2-45VHE-UNV-L835-CD1-U	4559	29.6	154
24CZ2-50VHE-UNV-L835-CD1-U	5064	32.7	155
24CZ2-55VHE-UNV-L835-CD1-U	5570	36.1	154
24CZ2-60VHE-UNV-L835-CD1-U	6055	38.7	157
24CZ2-65VHE-UNV-L835-CD1-U	6565	42.2	156
24CZ2-70VHE-UNV-L835-CD1-U	7059	45.7	155
24CZ2-75VHE-UNV-L835-CD1-U	7662	49.9	154
24CZ2-80VHE-UNV-L835-CD1-U	8128	53.8	151
24CZ2-85VHE-UNV-L835-CD1-U	8600	57.9	149
24CZ2-90VHE-UNV-L835-CD1-U	9053	61.8	147
24CZ2-95VHE-UNV-L835-CD1-U	9521	65.6	145
24CZ2-100VHE-UNV-L835-CD1-U	10191	69.6	146
24CZ2-110VHE-UNV-L835-CD2-U	11098	77.4	143
24CZ2-120VHE-UNV-L835-CD2-U	12211	83.6	146
24CZ2-130VHE-UNV-L835-CD2-U	13271	90.7	146
24CZ2-150VHE-UNV-L835-CD2-U	15006	104.2	144
24CZ2-170VHE-UNV-L835-CD2-U	17021	123.4	138

Shielding

Lumen Adjustment Factors		
S	HRP	SQR
1.05	0.81	0.96

Lumen Calculator

CCT Multiplier	80 CRI	90 CRI (1)
3000K	0.965	0.827
3500K	1.000	0.847
4000K	1.019	0.856
5000K	1.019	0.909

Notes: (1) Input wattages for 90 CRI versions may vary. Refer to published IES-format photometry or LM-79 reports for more details.

Example of Lumen Adjustment Calculation

24CZ2-40-UNV-L835-CD1-U at 90CRI at 3500K

Lumen Adjustment Factor = 0.845

Total Light Output =

4,196 lm x 0.845 = 3,546 lm

$$\textit{Efficacy} = \frac{3{,}546\ lm}{36.2W} = 98\ lm/W$$

Lumen Maintenance

Version	TM-21 Lumen Maintenance (60,000 hours) (2)	Theoretical L70 (Hours) (3)
Standard	> 87%	> 151,000
High Efficiency	> 90%	> 203,000
Very High Efficiency	> 90%	> 203,000

Notes: (2) Supported by IES TM-21 standards. (3) Theoretical values represent estimations commonly used; however, refer to the IES position on LED Product Lifetime Prediction, IES PS-10-18, that explains proper use of IES TM-21 and LM-80.

Load Data (Stock Product)

Thd	6%
Power Factor	0.99
Weight (lbs.)	16
Low Temp. Start	-20°C

Shipping Data

Catalog No.	Wt.	Pallet 49"L x 52"W x 46"H
2' x 4'	20.4 lbs.	28

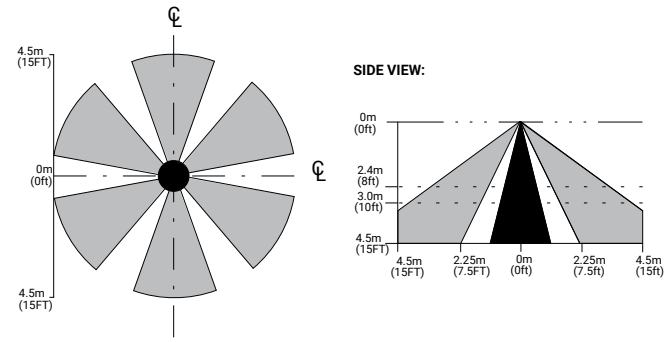
Air Return Volume

Negative Static Pressure (Inches H_2O)	Return Air Volume (CFM)
0.05	75
0.1	103
0.2	153
0.25	177
0.3	191
0.45	234

Control Systems

- WaveLinx PRO Wireless
- WaveLinx LITE Wireless
- WaveLinx Wired

Integrated Sensor Coverage Pattern



***Note**: Installation of integrated sensors within 3-ft (1m) of HVAC air vents is not recommended. The pattern shown is intended solely as a general guide and is not to scale.*

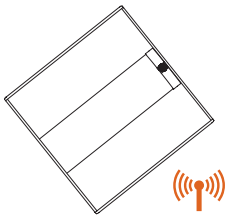
The Cruze ST with WaveLinx offers no-hassle lighting control with multiple luminaire level control solutions.

WaveLinx PRO is used for applications where spaces need to be connected to a lighting or building management system and to help building owners improve their operations, building environment, and tenants' experience by leveraging the data generated by the sensors. The WaveLinx PRO devices communicate with each other via the WaveLinx Area Controller which coordinates the data traffic between the devices, lighting apps and CORE platform. The WaveLinx Area Controller also hosts the time clock required if spaces need to be turned on/off at a specific time.

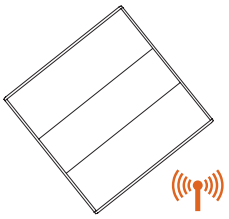
The WaveLinx PRO Sensor offers built-in occupancy and daylighting controls as well as luminaire level control including white tuning while the WaveLinx PRO Node offers luminaire level control and white tuning. If opting for the WaveLinx PRO Node option, a PRO Ceiling Sensor will most likely be needed within the space to control the lights based on occupancy and daylight levels.

WaveLinx LITE is used for single spaces where there is no need to manage the spaces remotely or exchange the sensor data with other sub-systems within the building or smart applications.

The WaveLinx LITE Sensor offers built-in occupancy and daylighting controls as well as luminaire level control.



With Integrated WaveLinx Sensor

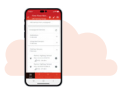


With Integrated WaveLinx Node

Systems comparison chart

Cooper Lighting Solutions provides many lighting system solutions designed to satisfy code requirements and meet the unique needs of any project.

Luminaire with standalone sensor



Standalone Spaces
WaveLinx LITE

Networked Spaces
WaveLinx PRO

Enterprise
WaveLinx CORE

	Luminaire with standalone sensor	Standalone Spaces WaveLinx LITE	Networked Spaces WaveLinx PRO	Enterprise WaveLinx CORE
Occupancy	Yes	Yes	Yes	Yes
Daylighting	Yes	Yes	Yes	Yes
Wallstations	–	Yes	Yes	Yes
Gateways	–	–	1 WAC	300 WACs
Devices (MAX)	–	50 per Area (1400 per site)	200 per WAC2	32,500 per CORE Enterprise
Software	–	WaveLinx LITE Mobile App	WaveLinx Mobile App	CORE
Areas	–	28 per Site	50 per WAC2	up to 3,000
Zones	–	16 per Area	16 per Area	up to 9,000
Scheduling	–	–	Local	Global
VividTune™	–	–	Yes	Yes
Plug-Load Control	–	–	Yes	Yes
Low-Voltage Power	–	–	Yes	Yes
Integration	–	–	–	BACnet, API
Dashboards	–	–	–	Energy, Occupancy
Configuration	–	Installer	Technician	Technician / IT

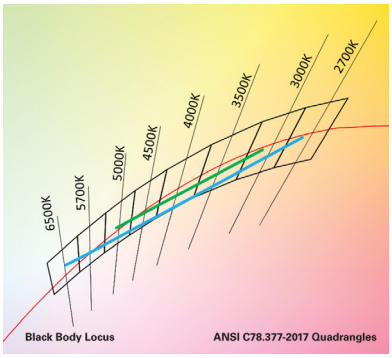
SCALABILITY

devices → areas → floors → buildings

VividTune™
color tuning solutions

24 Cruze ST LED with VividTune Tunable White

VividTune tunable white luminaires from Cooper Lighting Solutions deliver high-quality light in a broad range of continuously variable color temperatures and intensities. Create a dynamic environment by adjusting the ambient light warmer or cooler to influence mood, support the task at hand, or create a dramatic ambience. The ability to control correlated color temperature and intensity separately using simple controls is the next evolution of LED lighting for the commercial, educational, healthcare and hospitality space. The unparalleled flexibility and number of available lighting environments enable users to find the right light with tunable white.



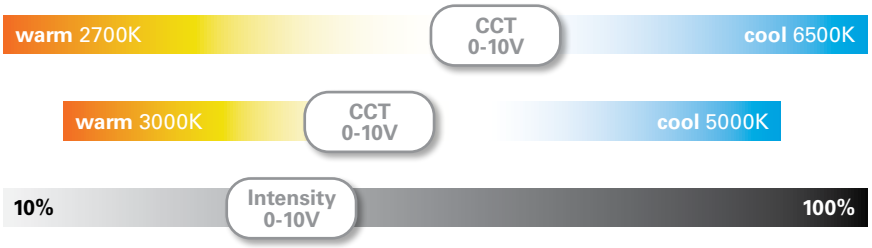
Performance Data*

Tunable White - Lumen Adjustment Factors				
CCT	3000K-5000K		2700K-6500K	
	80 CRI	90 CRI	80 CRI	90 CRI
2700K	-	-	0.878	0.750
3000K	0.904	0.744	0.903	0.779
3500K	0.956	0.813	0.934	0.819
4000K	1.004	0.878	0.954	0.844
4500K	1.014	0.893	0.972	0.866
5000K	1.014	0.893	0.985	0.884
6500K	-	-	0.999	0.908

2' x 4' Cruze ST LED - Example of Approximate Lumen Calculation			
	Standard Catalog #	VividTune 80 CRI Catalog #	VividTune 90 CRI Catalog #
CCT Setting	24CZ2-40HE-UNV-L835-CD1-U	24CZ2-40HE-UNV-L83050-W2A1-U	24CZ2-40HE-UNV-L93050-W2A1-U
3000K	-	3641	2998
3500K	4029	3853	3275
4000K	-	4046	3537
4500K	-	4084	3599
5000K	-	4084	3599

Controlling VividTune Tunable White

VividTune luminaires make tunable white more accessible by using simple and familiar controls. From wall dimmers to wireless controls, VividTune tunable white luminaires are compatible with industry standard 0-10V dimming controls. A single 0-10V dimming input is used to control intensity (brightness) while a second 0-10V dimming input is used to adjust CCT. For suggested control configurations, go to www.cooperlighting.com for tunable white application guides.



Example of Lumen Adjustment Calculation

24CZ2-40HE-UNV-L83050-W2A1-U
at 80 CRI tuned to 3500K

Adjusted Lumen =
published lm x adjusted lm factor

Adjusted Lumen = 4029 x 0.956

Adjusted Lumen = 3853 lm

** Lumen adjustment factors are for reference and may be different for each product selected. Refer to IES files for actual performance data on each.*

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1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

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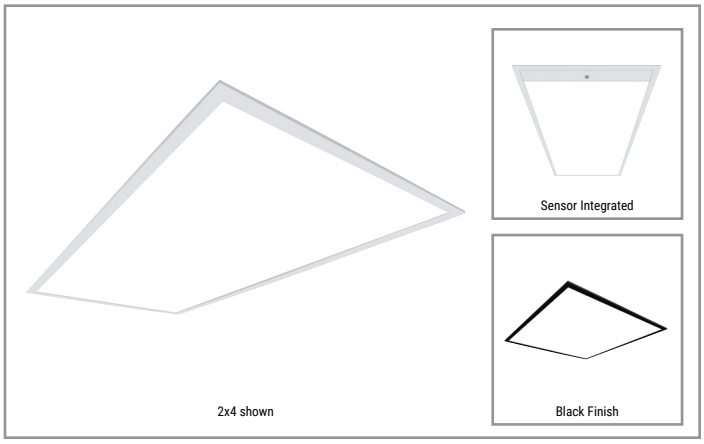
Specifications and dimensions subject to change without notice.

Project		**Catalog #**		**Type**	
Prepared by		**Notes**		**Date**	



Metalux

CGTX Panel

Configurable LED Panel,
Recessed, Surface, Suspended

Typical Applications

• Commercial Office Spaces • Schools • Healthcare
• Retail Merchandising Areas

Interactive Menu

- Order Information page 2
- Photometric Data page 5
- Control Systems page 7
- Product Warranty

Product Certification

Product Features

damp location

MWS MODULAR WIRING SYSTEM CLICK HERE

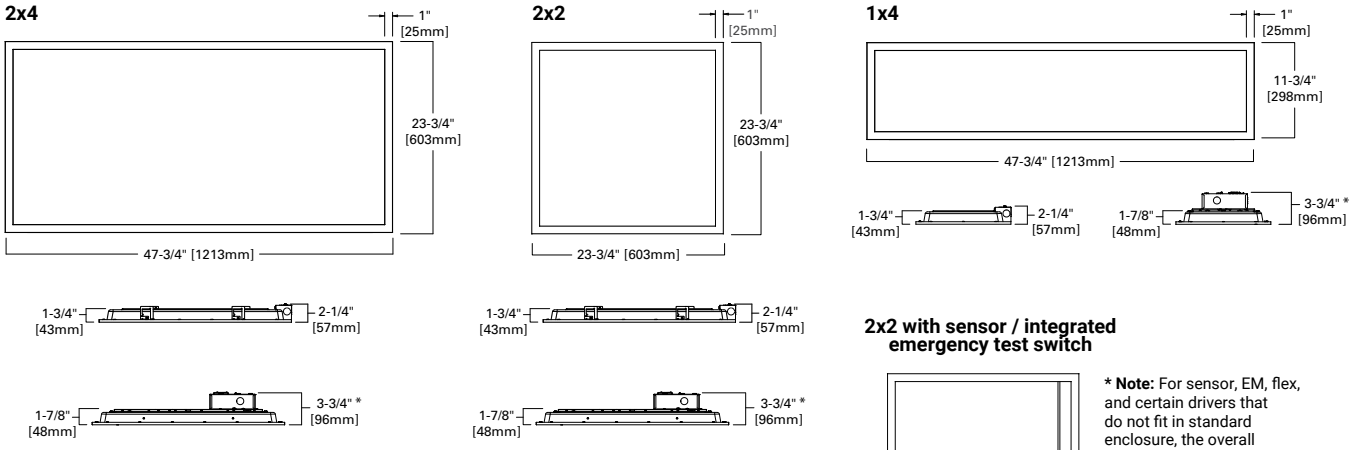
Bluetooth

Connected Systems

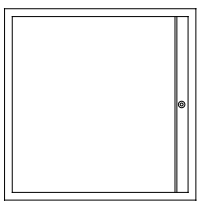
Top Product Features

- Highly configurable to fit a large variety of applications
- Integrated control and emergency options in all sizes
- Standard and high efficiency available for further energy savings
- Available in 3000K, 3500K, 4000K, and 5000K CCT, 80 and 90 CRI
- Options to meet Buy American and other domestic preference requirements

Dimensional and Mounting Details



2x2 with sensor / integrated emergency test switch



*** Note:** For sensor, EM, flex, and certain drivers that do not fit in standard enclosure, the overall height increases to 3-3/4".

additional product diagrams

Order Information

SAMPLE ORDER NUMBER: **24CGTX-40-EL14W-L840-WAA**

Domestic Preferences	Rating	Width/Length	Series	1x4 Lumen Output	2x2 Lumen Output	2x4 Lumen Output
[Blank]=Standard **BAA**=Buy American Act **TAA**=Trade Agreements Act	**[Blank]**=Standard **ATW-SW4**= Chicago Rated [2]	**14**=1' x 4' **22**=2' x 2' **24**=2' x 4'	**CGTX**=Configurable LED Panel	**Standard** **20**=2000 **30**=3000 **42**=4200 **High Efficiency** **20HE**=2000 **30HE**=3000 **42HE**=4200 **70HE**=7000 **80HE**=8000	**Standard** **20**=2000 **25**=2500 **35**=3500 **45**=4500 **High Efficiency** **20HE**=2000 **25HE**=2500 **35HE**=3500 **45HE**=4500 **50HE**=5000 **60HE**=6000	**Standard** **20**=2000 **30**=3000 **35**=3500 **40**=4000 **45**=4500 **55**=5500 **65**=6500 **72**=7200 **High Efficiency** **20HE**=2000 **30HE**=3000 **35HE**=3500 **40HE**=4000 **45HE**=4500 **55HE**=5500 **65HE**=6500 **72HE**=7200 **80HE**=8000 **90HE**=9000 **100HE**=10000 [4], [6]
Notes (1) Only product configurations with these designated prefixes are built to be compliant with the Buy American Act of 1933 (BAA) or Trade Agreements Act of 1979 (TAA), respectively. Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.	**Notes** (2) Installed Flex not available with ATW-SW4 option.			**Notes** (3) Lumens are approximate. Refer to performance tables and IES files for actual delivered lumens and wattage. (4) 2x4 100E lumen output requires two drivers. (6) 2x4 100 lumen output requires two drivers.		

Lens Options	Voltage	Emergency	CCT / CRI	Flex/MWS
[Blank]=Smooth White Frosted	**[Blank]**=Universal Voltage 120-277 **347V**=347 Volt [5]	**[Blank]**=None **EL7W**=7-watt, 120V-277V emergency battery pack installed [7] **EL14W**=14-watt 120V-277V emergency battery pack installed [7] **EL10W**=10-watt 120V-277V emergency battery pack installed [7] **EL10WSD**=10-watt 120V-277V emergency battery pack installed, with self-diagnostics [7] **GTRD**=Bodine Emergency Transfer Relay with dimming control [8] **ETRD**=Iota Emergency Transfer Relay with dimming control [9]	**L830**=3000K, 80 CRI **L835**=3500K, 80 CRI **L840**=4000K, 80 CRI **L850**=5000K, 80 CRI **L930**=3000K, 90 CRI [10] **L935**=3500K, 90 CRI [10] **L940**=4000K, 90 CRI [10] **90 CRI only available with HE**	**[Blank]**=None **Dimming Flex** [6] **A3/8-4/18GDIM**=Flex, hot, neutral, ground, 2 dimming leads **A3/8-5/18GDIM**=Flex, 2 hots, neutral, ground, 2 dimming leads **Non-Dimming Flex** [6] **A3/8-2/18G**=Flex, hot, neutral, ground **A3/8-3/18G**=Flex, 2 hots, neutral, ground **A3/8-4/18G**=Flex, 3 hots, neutral, ground **MWS - Modular Wiring Systems -** Fixture Fitting [13] **MW12FF12/3G**=120V Fixture Feed, #12, 3 Conductors + Ground [12] **MW27FF12/3G**=277V Fixture Feed, #12, 3 Conductors + Ground [12] **MW12FF12/2G-010V**=120V Fixture Feed, #12, 2 Conductors, Ground, 0-10V Dimming [12] **MW27FF12/2G-010V**=277V Fixture Feed, #12, 2 Conductors, Ground, 0-10V Dimming [12]
	Notes (5) 347V with sensor and/or emergencies only available with HCD.	**Notes** (6) Fixture height increases to 3-3/4". (7) With integral test switch/indicator. For approximate delivered lumens multiply the lumens per watt of the desired fixture by the wattage of the emergency battery pack (100 lm/W x 7=700 lumens). IES-format photometry for luminaire under emergency operation available. (8) Used to bypass local control during outage. Device is dual listed to UL 1008 (transfer switch) and UL 924 (switch bypass), 347V not available. (9) Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others). 347V not available.	**Notes** (10) 90 CRI only available in HE lumen packages.	**Notes** (6) Fixture height increases to 3-3/4". (11) Multiple options available in online configurator. See additional notes on Flex below. (12) To be used with Modular Wiring System. Refer to MWS Fixture Fitting specification for additional details.(13) MWS Fixture Fitting increases overall fixture height to 4-7/8". **Flexible Metal Conduit Options** Flex options available for 0-10V dimming control, DALI dimming control, emergency and night light functions. 72-inch factory-installed and pre-wired to driver, fitted to luminaire housing access plate with 90° enclosed FMC connector. Not all options may be combined and installation ratings vary by type.

Driver Type	Number of Drivers	Integrated Sensing Systems	Options	Packaging
[Blank]=CD 0-10V Driver (10%-100% Dimming) **HCD**=0-10V Driver (1%-100% Dimming) [6] **5LTD**=DALI Driver (1%-100% Dimming) [6] **SD**=Step Dimming Driver (50%,100% Dimming) [6] **LH**=Lutron HiLume (LDE1 series) 1%-100% EcoSystem Driver with Soft-on Fade to Black dimming [6], [F]	**[Blank]**=1 Driver **2**=2 Drivers [6]	**[Blank]**=No Sensor **WAA**=WaveLinx PRO Wireless Integrated Sensor [14], [A] **WPN**=WaveLinx PRO Wireless Node without Sensor [14], [A] **WAB**=WaveLinx LITE Wireless Integrated Sensor [14], [B]	**[Blank]**=None **BLKF**=Black Frame, Matte Finish	**[Blank]**=Unit Pack **PAL**=Job Pack, out of carton
Notes (6) Fixture height increases to 3-3/4". Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (F) Consult Marketplace Options - Lutron system pages for additional details and compatibility. Compatible only with driver series shown, and may require two or more drivers. Requires field commissioning to operate or dim. Contact Lutron at www.lutron.com.	**Notes** (6) Fixture height increases to 3-3/4".	**Notes** (6) Fixture height increases to 3-3/4". (14) Must be used with CD or HCD driver. Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (A) Consult WaveLinx PRO system pages for additional details and compatibility. (B) WaveLinx LITE devices are not currently compatible with the WaveLinx Wireless Area Controller. Consult WaveLinx LITE system pages for additional details and compatibility. (C) Consult WaveLinx Low-Voltage or DLVP system pages for additional details and compatibility. (D) Consult SVPD series system pages for additional details and compatibility.		

Product Specifications

Construction
- Robust die-formed steel back plate to ensure durability
- Housing is absent of holes to resist debris/bug intrusion
- Aluminum frame weld and ground for a seamless appearance

Mounting
- Integral grid/EQ clips provided and include suspension / wire retention features
- Grid clip includes fold up hang points. Use FPSUS24-ML or other desired suspension methods for direct suspension
- Large junction box constructed of code gauge galvanized steel with access plate
- Multiple 7/8" KO's provided, suitable for up to 12AWG wiring
- Surface kits available for use in grid or hard surfaces
- Factory installed MWS fixture fitting or flexible conduit available to reduce installation time
- FPSUS2-ML is a 2-point suspension kit includes aircraft cable, carabiner, ceiling connection, SO cord, cord connectors, round 4" J-box cover and #8 sheet metal screws

Controls
- 0-10V dimming to 10% standard, 1% dimming available
- WaveLinx wireless sensor compatible for standalone, controlled, connected, and IoT capability
- DALI 2.0, Lutron, and step-dimming available

Electrical
- TM21 life at 60,000 hours up to L86 and calculated L70 exceeds 120,000 hrs
- Driver rated for FCC part 15 Class B for use in residential or commercial applications
- LED's available in 3000K, 3500K, 4000K, or 5000K at 80 CRI or 90 CRI minimum
- Color accuracy ≤3-Step MacAdam ellipse (SDCM)
- Integral emergency battery pack options available in 7W, 10W, and 14W. Test switch located on fixture lens band. Self-diagnostic options available
- Emergency/generator transfer options available
- Drivers available in 120-277V; 0-10V drivers also available in 347V

Optical Shielding
- Micro-optics enable uniform distribution of the LEDs for uniform lens illumination
- Frosted smooth lens provides uniform illumination across the entire lens
- Durable lens with surface texture to minimize scratch and impact damage

Compliance
- cULus listed for 25°C ambient environments, indoor applications
- IC rated for direct insulation contact
- UL Damp Location listed
- IP5X rated from the room side with no modification needed
- Tested to IESNA LM-79 and LM-80
- Stated life per TM21 standards
- DesignLights Consortium® Qualified and classified for DLC Standard and DLC Premium, refer to www.designlights.org for details.
- Suitable for State of California Title 24 high efficacy luminaire
- FCC part 15 class B (residential) compliant with standard 10% dimming driver; battery packs excluded
- Fixture is rated for NSF/ANSI standard 2 - Light fixture for Splash Zone and Non-Food Zone

Warranty
- Five year warranty
- Extended warranty to 10 years available

Surface Mounting Options

Catalog No.	Description	UPC	Kit Height
CGTSURF24	2x4 CGT Surface Mount Kit	080083083107	3-7/8"
CGTSURF22	2x2 CGT Surface Mount Kit	080083083121	3-7/8"
CGTSURF14	1x4 CGT Surface Mount Kit	080083083145	3-7/8"
SK-24-WS	2x4 SK Surface Mount Kit, Shallow	080083719389	5-1/16"
SK-22-WS	2x2 SK Surface Mount Kit, Shallow	080083719402	5-1/16"
SK-14-WT	1x4 SK Surface Mount Kit, Tall	080083906703	6-1/4"
Note: Cannot be used with EL10W, EL10WSD, GTRD, 100HE lumen output, MWS, or 347V with alternative driver. Metalux Universal Surface Mount kits are compatible with these configurations – see #SK-24, #SK-22, and #SK-14). Metalux Universal Surface Mount			

Shipping Data

	1x4	2x2	2x4
Packaged Weight (lb.)	10	10	16
Pallet Qty - Standard (Tall)	17 (11)	34 (22)	16 (11)
Pallet Size	30x53		
Note: Base configurations; options may add weight.			

Drywall Frame Kit

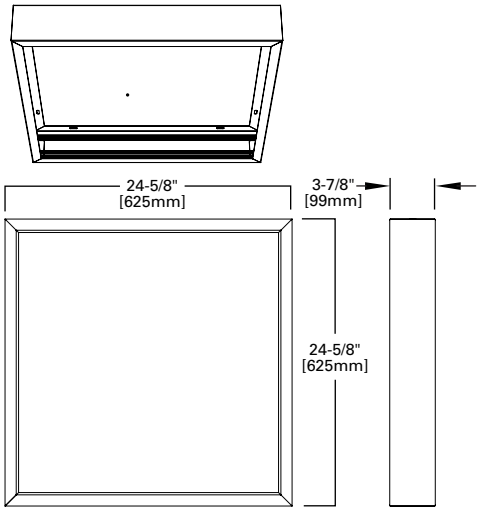
Catalog No.	Description	UPC
DF-24W-U	2x4 dry wall frame kit	662401232970
DF-22W-U	2x2 dry wall frame kit	662401232963
DF-14W-U	1x4 dry wall frame kit	662401232949

Surface Mount Kit

Size	Width	Length
1x4	12-5/8"	48-5/8"
2x2	24-5/8"	24-5/8"
2x4	24-5/8"	48-5/8"

Suspension Kit

Catalog	UPC	Description
FPSUS2-ML	080083802784	ML / Max Load Kit for CGTX with options. 2 point Y-hanger suspension kit includes aircraft cable, carabiner, ceiling connection, SO cord, cord connectors, round 4" J-box cover plate, and #8 sheet metal screws.
Mounting height from ceiling **Min.**=7-1/4" [184mm] **Max.**=27" [286mm] **Note**: Suspension kit is intended to be used without surface mount box.		



CGTSURF22 Shown

Energy and Performance Data

Electrical & Optical Performance - CGTX (3500K, 80 CRI)

Size	Lumen Pkg	Delivered Lumens	Input Watts	Efficacy lm/W	Current (A)		Glare Performance	
					120V	277V	UGR (1)	Max Luminance (1)
1x4	2000	1815	16.4	111	0.14	0.06	18.3	1590
	3000	2679	23.9	112	0.20	0.09	19.7	2347
	4200	3911	31.7	123	0.26	0.11	21.0	3427
1x4 HE	2000 HE	1877	14.8	127	0.12	0.05	18.4	1645
	3000 HE	2820	22.4	126	0.19	0.08	19.9	2471
	4200 HE	3984	31.9	125	0.27	0.12	21.1	3491
	7000 HE	6372	52.5	121	0.44	0.19	22.7	5583
	8000 HE	7346	61.9	119	0.52	0.22	23.2	6437
2x2	2000	1937	15.1	128	0.13	0.05	18.6	1695
	2500	2407	18.9	127	0.16	0.07	19.3	2106
	3500	3422	27.9	123	0.23	0.10	20.6	2994
	4500	4199	36.1	116	0.30	0.13	21.3	3673
2x2 HE	2000 HE	1921	14.8	130	0.12	0.05	18.6	1681
	2500 HE	2466	19.2	128	0.16	0.07	19.4	2157
	3500 HE	3448	27.2	127	0.23	0.10	20.6	3016
	4500 HE	4413	36.2	122	0.30	0.13	21.5	3861
	5000 HE	4860	40.0	122	0.33	0.14	21.8	4252
	6000 HE	5698	47.4	120	0.40	0.17	22.3	4985
2x4	2000	2178	16.7	130	0.14	0.06	16.7	958
	3000	3059	23.7	129	0.20	0.09	17.9	1345
	3500	3652	28.4	129	0.24	0.10	18.5	1606
	4000	3911	30.3	129	0.25	0.11	18.7	1720
	4500	4537	35.6	127	0.30	0.13	19.3	1995
	5500	5412	44.1	123	0.37	0.16	19.9	2380
	6500	6447	53.4	121	0.45	0.19	20.5	2835
	7200	7237	60.9	119	0.51	0.22	20.9	3182
2x4 HE	2000 HE	1982	14.9	133	0.12	0.05	16.4	871
	3000 HE	2916	21.9	133	0.18	0.08	17.7	1282
	3500 HE	3396	25.6	133	0.21	0.09	18.2	1493
	4000 HE	3954	29.9	132	0.25	0.11	18.8	1739
	4500 HE	4550	34.7	131	0.29	0.13	19.3	2001
	5500 HE	5376	41.3	130	0.34	0.15	19.8	2364
	6500 HE	6451	49.9	129	0.42	0.18	20.5	2837
	7200 HE	6801	53.6	127	0.45	0.19	20.7	2990
	8000 HE	7979	63.5	126	0.53	0.23	21.2	3508
	9000 HE	8784	70.3	125	0.59	0.25	21.5	3862
	10000 HE	10199	82.6	123	0.69	0.30	22.1	4485

Notes:
(1) UGR values per CIE 190:2010 with 4H, 8H, Reflectance: 70% Ceiling, 50% Wall, 20% Ref. Plane.
Luminance measured at 45-90 degrees from nadir.
UGR and Luminance values that meet WELL v2 L04 requirements for Managing Glare are shown with green highlighted cell (UGR < 16, Luminance < 6,000).
UGR and Luminance values that meet LEED v4.1 requirements for Glare Control are shown with green text (UGR < 19, Luminance < 7,000).

Key

	Meets WELL v2
TEXT	Meets LEED v4.1

Lumen Adjustment Factors

CCT Multiplier	80 CRI	90 CRI (2)
3000K	0.99	0.83
3500K	1.00	0.85
4000K	1.03	n/a
5000K	1.05	0.89

Notes: (2) 90 CRI only available in HE lumen outputs.

Example of Lumen Adjustment Calculation

24CGTX-45-L850
at 5000K

Lumen Adjustment Factor = 1.05

Total Light Output =
4,537 lm x 1.05 = 4,764 lm

$$\textit{Efficacy} = \frac{4{,}764\ lm}{35.6\ W} = 133\ lm/W$$

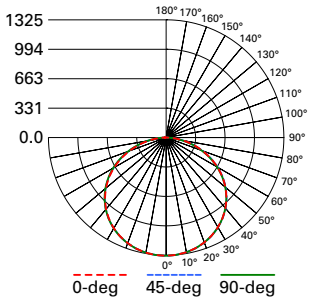
Lumen Maintenance

TM-21 Lumen Maintenance (60,000 hours) (3)	Theoretical L70 (Hours) (4)
> 86%	> 120,000

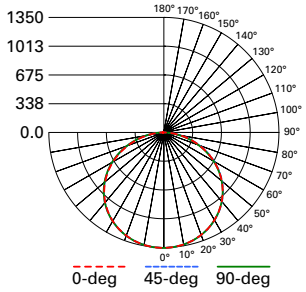
Notes: (3) Supported by IES TM-21 standards. (4) Theoretical values represent estimations commonly used; however, refer to the IES position on LED Product Lifetime Prediction, IES PS-10-18, that explains proper use of IES TM-21 and LM-80.

Photometric Data

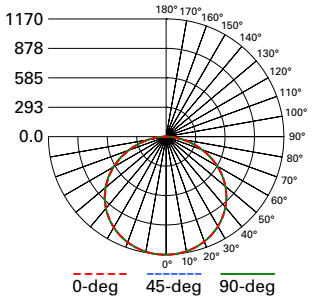
View IES files



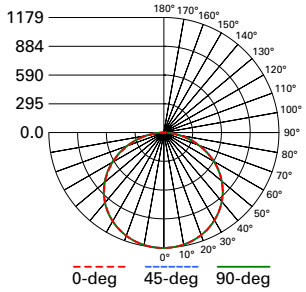
14CGTX-42-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.27 x mounting height
Lumens: 3911
Input Watts: 31.7W
Efficacy: 123 LPW
Test Report: 14CGTX-42-L835.IES



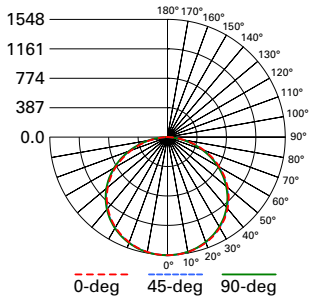
14CGTX-42HE-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.27 x mounting height
Lumens: 3984
Input Watts: 31.9W
Efficacy: 125 LPW
Test Report: 14CGTX-42HE-L835.IES



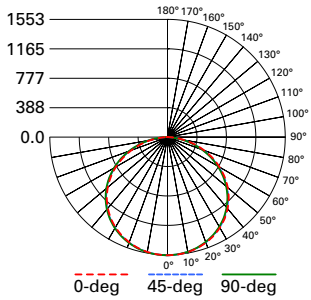
22CGTX-35-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.26 x mounting height
Lumens: 3422
Input Watts: 27.9W
Efficacy: 123 LPW
Test Report: 22CGTX-35-L835.IES



22CGTX-35HE-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.26 x mounting height
Lumens: 3448
Input Watts: 27.2W
Efficacy: 127 LPW
Test Report: 22CGTX-35HE-L835.IES



24CGTX-45-L835
Electronic Driver
LED 4000K
Spacing criterion: (II) 1.27 x mounting height, (⊥) 1.26 x mounting height
Lumens: 4537
Input Watts: 35.6W
Efficacy: 127 LPW
Test Report: 24CGTX-45-L835.IES

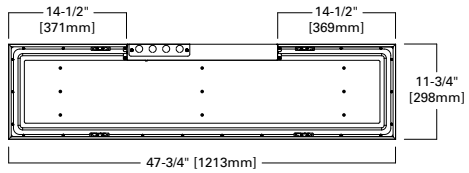


24CGTX-45HE-L835
Electronic Driver
LED 4000K
Spacing criterion: (II) 1.27 x mounting height, (⊥) 1.26 x mounting height
Lumens: 4550
Input Watts: 34.7W
Efficacy: 131 LPW
Test Report: 24CGTX-45HE-L835.IES

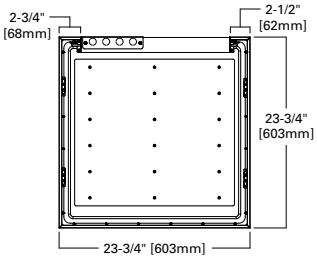
Dimensional and Mounting Details

Standard driver - no controls, EM, or flex

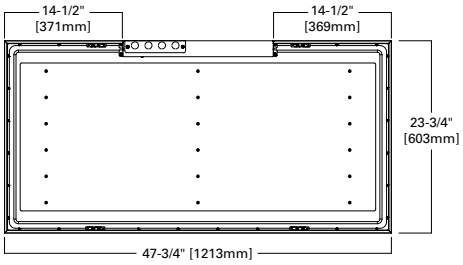
1x4



2x2

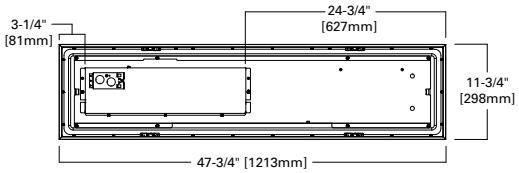


2x4

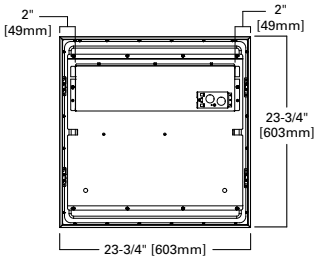


Alternative driver, with controls, EM and/or flex

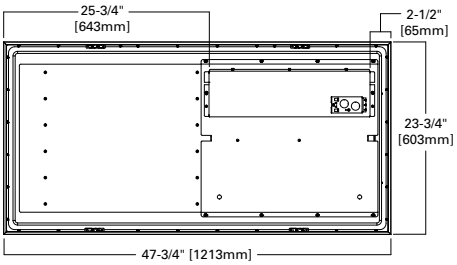
1x4



2x2



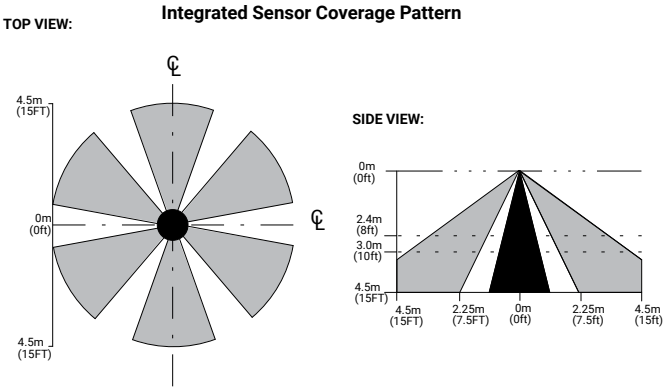
2x4



Control Systems

- WaveLinx PRO Wireless
- WaveLinx LITE Wireless
- WaveLinx Wired

Integrated Sensor Coverage Pattern



***Note**: Installation of integrated sensors within 3-ft (1m) of HVAC air vents is not recommended. The pattern shown is intended solely as a general guide and is not to scale.*

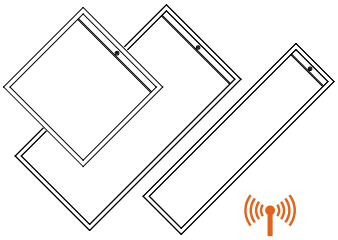
The CGTX with WaveLinx offers no-hassle lighting control with multiple luminaire level control solutions.

WaveLinx PRO is used for applications where spaces need to be connected to a lighting or building management system and to help building owners improve their operations, building environment, and tenants' experience by leveraging the data generated by the sensors. The WaveLinx PRO devices communicate with each other via the WaveLinx Area Controller which coordinates the data traffic between the devices, lighting apps and CORE platform. The WaveLinx Area Controller also hosts the time clock required if spaces need to be turned on/off at a specific time.

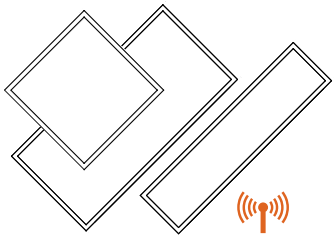
The WaveLinx PRO Sensor offers built-in occupancy and daylighting controls as well as luminaire level control including white tuning while the WaveLinx PRO Node offers luminaire level control and white tuning. If opting for the WaveLinx PRO Node option, a PRO Ceiling Sensor will most likely be needed within the space to control the lights based on occupancy and daylight levels.

WaveLinx LITE is used for single spaces where there is no need to manage the spaces remotely or exchange the sensor data with other sub-systems within the building or smart applications.

The WaveLinx LITE Sensor offers built-in occupancy and daylighting controls as well as luminaire level control.



With Integrated WaveLinx Sensor



With Integrated WaveLinx Node

Systems comparison chart

Cooper Lighting Solutions provides many lighting system solutions designed to satisfy code requirements and meet the unique needs of any project.

Luminaire with standalone sensor

Standalone Spaces
WaveLinx LITE

Networked Spaces
WaveLinx PRO

Enterprise
WaveLinx CORE

	Luminaire with standalone sensor	Standalone Spaces WaveLinx LITE	Networked Spaces WaveLinx PRO	Enterprise WaveLinx CORE
Occupancy	Yes	Yes	Yes	Yes
Daylighting	Yes	Yes	Yes	Yes
Wallstations	–	Yes	Yes	Yes
Gateways	–	–	1 WAC	300 WACs
Devices (MAX)	–	50 per Area (1400 per site)	200 per WAC2	32,500 per CORE Enterprise
Software	–	WaveLinx LITE Mobile App	WaveLinx Mobile App	CORE
Areas	–	28 per Site	50 per WAC2	up to 3,000
Zones	–	16 per Area	16 per Area	up to 9,000
Scheduling	–	–	Local	Global
VividTune™	–	–	Yes	Yes
Plug-Load Control	–	–	Yes	Yes
Low-Voltage Power	–	–	Yes	Yes
Integration	–	–	–	BACnet, API
Dashboards	–	–	–	Energy, Occupancy
Configuration	–	Installer	Technician	Technician / IT

SCALABILITY

devices → areas → floors → buildings

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Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

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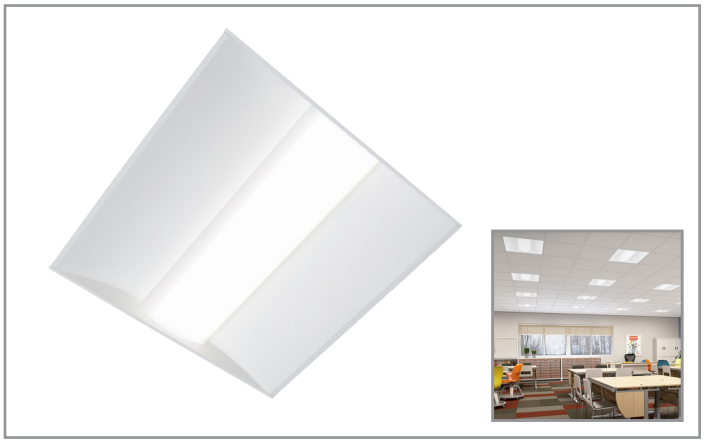
Specifications and dimensions subject to change without notice.

Project		**Catalog #**		**Type**	
Prepared by		**Notes**		**Date**	



Metalux

Cruze ST 22CZ2

2' x 2' LED Specification Grade Troffer

Typical Applications

Office • Education • Healthcare • Hospitality • Retail

Interactive Menu

- Order Information page 2
- Photometric Data page 3
- Connected Systems page 5
- VividTune™ Color Tuning Solutions page 6
- Product Warranty

Product Certification

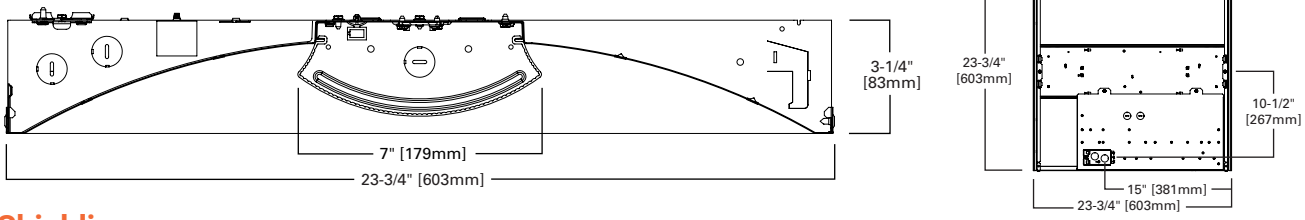
Product Features

Connected Systems · Bluetooth · damp location · VividTune · BAA · LINEAR DISCONNECT (Designed to provide safe and convenient means of disconnecting power) · MWS MODULAR WIRING SYSTEM CLICK HERE · Rapid Response CLICK HERE

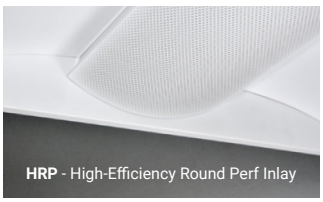
Top Product Features

- Latch-less design provides clean architectural look
- VividTune CCT tuning options from 3000K-5000K or 2700K-6500K
- Designers delight - ribbed, smooth and round perforated lens options
- High performance efficacy up to 151 lm/W
- Integrated sensor systems - occupancy, daylight and IoT connectivity
- Options to meet Buy American and other domestic preference requirements

Dimensional and Mounting Details



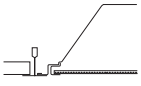
Shielding



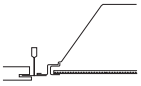
See ordering information for more shielding options.

Ceiling Compatibility

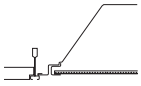
G Grid/Lay-in Standard



G Concealed T



G Slot Grid



Ceiling Type	Trim Type
Exposed Grid	Standard
Concealed T	Standard
Slot Grid	Standard
Flange	*

*See Drywall Frame Kit Accessory in Ordering Information Section

Order Information

SAMPLE ORDER NUMBER: **22CZ2-34HE-UNV-L835-CD1-U**

Domestic Preferences	Rating	Series	Air	Lumen Output			Shielding	Voltage	Options
Domestic Preferences [1]	**Rating**	**Series**	**Air**	**Lumen Level**		**Efficacy**	**Shielding**	**Voltage** [9]	**Options**
[Blank]=Standard **BAA**=Buy American Act **TAA**=Trade Agreements Act	**[Blank]**=Standard **ATW-SW4**=Chicago Rated	**22CZ2**=2x2 Cruze ST	**[Blank]**=Standard **A**=Air (Vented) [2]	**20**=2000 Lumens **24**=2400 Lumens **29**=2900 Lumens [8] **32**=3200 Lumens [7] **34**=3400 Lumens [8] **39**=3900 Lumens **44**=4400 Lumens **50**=5000 Lumens [6] **55**=5500 Lumens [6] **60**=6000 Lumens [6] **65**=6500 Lumens [6]	**70**=7000 Lumens [6] **75**=7500 Lumens [6] **80**=8000 Lumens [6] **85**=8500 Lumens [6] **90**=9000 Lumens [6] **95**=9500 Lumens [6] **100**=10000 Lumens [6] **110**=11000 Lumens [6]	**[Blank]**=Standard Efficacy [4], [5] **HE**=High Efficacy [5] **VHE**=Very High Efficacy [6]	**[Blank]**=Ribbed Frosted Acrylic Lens (standard) **S**=Smooth Frosted Acrylic Lens **HRP**=High-Efficiency Round Perf Inlay **SQR**=Square Ribbed Frosted Acrylic Lens	**UNV**=Universal Voltage 120-277 **347V**=347 Volt **48V**=48 Volt Low-voltage (Class 2) [C]	**GL**=Single Element Fuse **GM**=Double Element Fuse **PAF**=Painted After Fabrication
Notes (1) Only product configurations with these designated prefixes are built to be compliant with the Buy American Act of 1933 (BAA) or Trade Agreements Act of 1979 (TAA), respectively. Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.			**Notes** (2) Air version is intended for air return through plenum. See air return data table for air flow volumes. Air option not available with ATW-SW4. Air requires "PAF" option.	**Notes** (4) White tuning not available with this model. (5) Available up to 4400 lumens. (6) Available with CD and HCD drivers only. (7) Only available in Standard Efficacy. (8) Not available in Standard Efficacy.				**Notes** (9) Products also available in non-US voltages and frequencies for international markets. (C) Consult WaveLinx Low-Voltage or DLVP system pages for additional details and compatibility.	

Emergency Options	CRI/CCT	Flex
Emergency Options	**CRI/CCT**	**Flex**
[Blank]=No emergency **EL7W**=7-watt 120V-277V emergency battery pack [10] **EL10W**=10-watt 120V-277V emergency battery pack [10] **EL14W**=14-watt 120V-277V emergency battery pack [10] **EL10WSD**=10W emergency battery pack with self-diagnostic installed [10], [12] **EL14WSD**=14W emergency battery pack with self-diagnostic installed [10], [12] **ELV7W**=Low-voltage system, 7-watt emergency battery pack [C] **ELV14W**=Low-voltage system, 14-watt emergency battery pack [C] **ETRD**=Emergency Transfer Relay with dimming control [11] **RRU**=LVS Controls Emergency Transfer Relay with dimming control [11] **UEL7W**=UL924 Listed luminaire, 7-watt, 120V-277V emergency battery pack [10] **UEL14W**=UL924 Listed luminaire, 14-watt 120V-277V emergency battery pack [10] **UEL10WSD**=Bodine 10W emergency battery pack with self diagnostic installed [10], [13] **UETRD**=UL924 Listed luminaire, Emergency Transfer Relay with dimming control [11] **URRU**=UL924 Listed luminaire, LVS Controls Emergency Transfer Relay with dimming control [11]	**L830**=80CRI, 3000K **L835**=80CRI, 3500K **L840**=80CRI, 4000K **L850**=80CRI, 5000K **L930**=90CRI, 3000K **L935**=90CRI, 3500K **L940**=90CRI, 4000K **L950**=90CRI, 5000K **L83050**=80CRI 3000K-5000K White Tuning [14] **L93050**=90CRI 3000K-5000K White Tuning [14] **L82765**=80CRI 2700K-6500K White Tuning [14] **L92765**=90CRI 2700K-6500K White Tuning [14]	**[Blank]**=No Flex **A3/8-4/18GDIM**=3/8" Flex with 0-10V Dimming Leads **A3/8-2/18G**=3/8" Flex with line and common **A3/8-5/18GDIM**=Flex with 0-10V Dimming leads and Blue for alternate wiring. See below for details.
Notes (10) Factory installed with integral test switch/indicator/laser test. For approximate delivered lumens multiply the lumens per watt of the desired fixture by the wattage of the emergency battery pack (100 lm/W x 7=700 lumens). IES-format photometry for luminaire under emergency operation available. Battery option increases total height by 1 inch. (11) Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others). Devices are universal voltage (UNV). 347 not available. (12) EL10WSD and EL14WSD not available with 347V. (13) UEL10WSD not available with 347V. (C) Consult WaveLinx Low-Voltage or DLVP system pages for additional details and compatibility.	**Notes** (14) White tuning provides correlated color temperatures (CCT) between 3000K (warm) to 5000K (cool) or 2700K (warm) to 6500K (cool). Must be used in conjunction with W2A driver only. Must be used with two (2) 10V dimming control channels, 1 color, 1 intensity. May be combined with Wavelinx sensor control systems only.	**Flexible Metal Conduit Options** Flex options available for 0-10V dimming control, DALI dimming control, emergency and night light functions. 72-inch factory-installed and pre-wired to driver, fitted to luminaire housing access plate with 90° enclosed FMC connector. Not all options may be combined and installation ratings vary by type. See online configurator for all flex options. **A3/8-4/18GDIM series notes:** Factory installed dimming option 3/8" flexible metal conduit with 2-#18 power and ground wires and 2-#18 UL-listed jacketed 0-10V +/- control wires. Meets UL 66, 83, 1479, 1569, 1581, 2556. NEC® 250.118, 300.22(C), 392, 396, 330, 501, 502, 503, 530, 504, 505, 518, 520, 530, 645, 72; Federal Specification A-A-59544 (formerly J-C-30B); all applicable OSHA and HUD Requirements. UL Classified 1-, 2-, and 3-hour through penetration with applicable fire stop product (not included). May be surface mounted, fished and/or embedded in plaster. Cable tray and approved raceway rated, install per NEC®; Environmental Air-Handling Space Installation per NEC® 300.22(C).

Driver Type	Number of Drivers	Integrated Sensing Systems	Packaging	Accessories
CD=0-10V Driver (10%-100% Dimming) **HCD**=0-10V Driver (1%-100% Dimming) **5LTD**=DALI Driver (5%-100% Dimming) **5LTHD**=DALI Driver (1%-100% Dimming) **LV**=Low-voltage System Driver (0%-100% Dimming) (C) **SD**=Step Dimming Driver (50%-100% Dimming) **LH**=Lutron HiLume (LDE1 series) 1%-100% EcoSystem Driver with Soft-on Fade to Black dimming (F) **W2A**=White Tuning, 2 ch, Analog 0-10V Intensity and CCT Control (15) **SR**=Sensor-ready Driver (1%-100% Dimming)	**1**=1 Driver	**[Blank]**=No Sensor **WAA**=WaveLinx PRO Wireless Integrated Sensor (17), (A) **WPN**=WaveLinx PRO Wireless Node without Sensor (17), (A) **WAB**=WaveLinx LITE Wireless Integrated Sensor (18), (B) **WLA**=Low-voltage Integrated Sensor (19), (C)	**U**=Unit Pack **PAL**=Job Pack, out of carton **PALC**=Job Pack, in carton	**CZ2-EQCLIP-U-PK**="CZ2" Earthquake Clip Kit (4 clips per bag kit) (21) **DF-22W-U**=2' x 2' Drywall Frame Kit **SK-22-WS**=2' x 2' Shallow Surface Mount Kit **SK-22-WT**=2' x 2' Tall Surface Mount Kit
Notes (15) White tuning provides correlated color temperatures (CCT) between 3000K (warm) to 5000K (cool) or 2700K (warm) to 6500K (cool). Must be used in conjunction with W2A driver only. Must be used with two (2) 10V dimming control channels, 1 color, 1 intensity. May be combined with Wavelinx sensor control systems only. Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (C) Consult WaveLinx Low-Voltage or DLVP system pages for additional details and compatibility. (F) Consult Marketplace Options - Lutron system pages for additional details and compatibility. Compatible only with driver series shown, and may require two or more drivers. Requires field commissioning to operate or dim. Contact Lutron at www.lutron.com.		**Notes** (16) Matching width lens band on other side of sensor band may be supplied for symmetrical appearance. Required for use with sensor and emergency combination. Add "D" to sensor ordering as shown - WAAD, WABD. (17) WAA sensor and WPN node to be used with CD, HCD or W2A driver. Consult factory for WPN with tunable white W2A driver. (18) WAB sensor to be used with CD or HCD driver. (19) WLA sensor to be used with LV driver. Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (A) Consult WaveLinx PRO system pages for additional details and compatibility. (B) WaveLinx LITE devices are not currently compatible with the WaveLinx Wireless Area Controller. Consult WaveLinx LITE system pages for additional details and compatibility. (C) Consult WaveLinx Low-Voltage or DLVP system pages for additional details and compatibility.		**Notes** (21) An EQ Grid Clip is recommended for all 9/16" ceiling systems. Four required per fixture. (22) Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information. Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories.

Product Specifications

Construction
- Die formed of code gauge prime cold rolled steel with full length die-formed stiffeners
- Unibody endplates attached with interlocking tabs and screws
- Hemmed side flanges
- Four auxiliary fixture end suspension points
- Integral Grid-lock feature for endplates for added safety
- Optional earthquake clips available

Integrated Controls
- Standard with 0-10V dimming driver (10% standard, 1% optional)
- WaveLinx wireless sensor compatible for standalone, controlled, connected, and IoT capability
- SVPD sensor compatible for standalone functionality
- Low-voltage sensor and driver compatible for WaveLinx Low-Voltage and DLVP applications
- DALI 2.0, Lutron, and step-dimming available

LED and Light Engine
- LED's available in 3000K, 3500K, 4000K, or 5000K at 80 CRI minimum and 90 CRI minimum
- Color accuracy ≤3-Step MacAdam ellipse (SDCM)
- TM21 life at 60,000 hours up to L90 and calculated L70 exceeds 203,000 hrs.
- Drivers available in 120-277V and 347V
- Tunable white options available with Cooper Lighting Solutions' Vividtune

Emergency Battery Options
- 120V-277V integral emergency battery pack comes in 7-watts, 10-watt, or 14-watts
- Self-diagnostic emergency battery available in 10 or 14-watts (NFPA 101® Life Safety Code®)
- Constant power to the LED system for controlled, predictable discharge
- Integrated test switch/indicator light visible from floor
- Min. 90-minute backup period for code compliance
- Integral emergency transfer relay available for generator equipped power systems

Shielding
- Ribbed acrylic frosted lens standard
- Optional smooth acrylic frosted lens (S)
- Optional square ribbed frosted acrylic lens (SQR)
- Optional High-Efficiency Round Perf Inlay (HRP)
- Replacement lenses available, contact factory

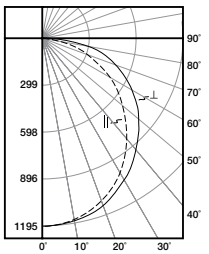
Compliance
- IC rated for insulation contact
- cULus listed for damp locations
- RoHS compliant
- Tested to IESNA LM-79 and LM-80
- Stated life tested to TM21 standards
- Can be used for State of California Title 24 high efficacy luminaire

Warranty
- Five-year warranty standard. Optional ten year warranty available.

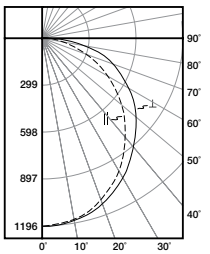
Finish
- Multistage, iron phosphate pretreatment
- 90% reflective, matte white enamel finish
- Full fixture housing pre-painted matte white (choose PAF option for "Paint after Fabrication")

Photometric Data

View IES files



22CZ2-24-UNV-L830-CD1-U
Dimming Driver
Linear LED 3000K
Spacing criterion: (II) 1.2 x mounting height, (⊥) 1.28 x mounting height
Lumens: 2437
Input Watts: 21.9W
Efficacy: 111.3 LPW
Test Report: 22CZ2-24-UNVL830-CD1-U.IES



22CZ2-24HE-UNV-L830-CD1-U
Dimming Driver
Linear LED 3000K
Spacing criterion: (II) 1.19 x mounting height, (⊥) 1.27 x mounting height
Lumens: 2402
Input Watts: 19.2W
Efficacy: 125.1 LPW
Test Report: 14CZ2-29-UNV-L830-CD1-U.IES

Energy and Performance Data

Standard Efficacy Versions – Single Row of LEDs
Default CCT/Lumen Setting: 3500K/Med

Catalog Number	Lumens	Watts	lm/W
22CZ2-20-UNV-L835-CD1-U	2142	16.2	132
22CZ2-24-UNV-L835-CD1-U	2454	18.5	133
22CZ2-32-UNV-L835-CD1-U	3272	24.2	135
22CZ2-39-UNV-L835-CD1-U	3953	31	128
22CZ2-44-UNV-L835-CD1-U	4462	33	134

High Efficacy Versions – Two Rows of LEDs

Catalog Number	Lumens	Watts	lm/W
22CZ2-20HE-UNV-L835-CD1-U	2030	15.0	135
22CZ2-24HE-UNV-L835-CD1-U	2474	18.1	137
22CZ2-29HE-UNV-L835-CD1-U	2982	20.9	143
22CZ2-34HE-UNV-L835-CD1-U	3426	24.3	141
22CZ2-39HE-UNV-L835-CD1-U	3997	28.5	140
22CZ2-44HE-UNV-L835-CD1-U	4567	32.8	139

Very High Efficacy Versions – Three Rows of LEDs

Catalog Number	Lumens	Watts	lm/W
22CZ2-20VHE-UNV-L835-CD1-U	2008	14.2	141
22CZ2-24VHE-UNV-L835-CD1-U	2501	17.5	143
22CZ2-29VHE-UNV-L835-CD1-U	3114	21.7	144
22CZ2-34VHE-UNV-L835-CD1-U	3598	25.1	143
22CZ2-39VHE-UNV-L835-CD1-U	4078	28.6	143
22CZ2-44VHE-UNV-L835-CD1-U	4620	32.6	142
22CZ2-50VHE-UNV-L835-CD1-U	5095	36.2	141
22CZ2-55VHE-UNV-L835-CD1-U	5530	39.4	140
22CZ2-60VHE-UNV-L835-CD1-U	6110	44.1	139
22CZ2-65VHE-UNV-L835-CD1-U	6559	47.9	137
22CZ2-70VHE-UNV-L835-CD1-U	7017	50.3	140
22CZ2-75VHE-UNV-L835-CD1-U	7557	54.7	138
22CZ2-80VHE-UNV-L835-CD1-U	8092	59.1	137
22CZ2-85VHE-UNV-L835-CD1-U	8615	63.6	136
22CZ2-90VHE-UNV-L835-CD1-U	9125	68.2	134
22CZ2-95VHE-UNV-L835-CD1-U	9610	72.7	132
22CZ2-100VHE-UNV-L835-CD1-U	10108	77.7	130
22CZ2-110VHE-UNV-L835-CD1-U	11065	87.7	126

Shielding

Lumen Adjustment Factors		
S	HRP	SQR
1.05	0.80	0.96

Lumen Calculator

CCT Multiplier	80 CRI	90 CRI (1)
3000K	0.965	0.827
3500K	1.000	0.847
4000K	1.019	0.856
5000K	1.019	0.909

Notes: (1) Input wattages for 90 CRI versions may vary. Refer to published IES-format photometry or LM-79 reports for more details.

Example of Lumen Adjustment Calculation

22CZ2-32-UNV-L935-CD1-U at 90CRI at 3500K

Lumen Adjustment Factor = 0.845

Total Light Output =

3,280 lm x 0.845 = 2,772 lm

$$\textit{Efficacy} = \frac{2{,}772\ lm}{26.7W} = 103.8\ lm/W$$

Lumen Maintenance

Version	TM-21 Lumen Maintenance (60,000 hours) (2)	Theoretical L70 (Hours) (3)
Standard	> 85%	> 151,000
High Efficiency	> 90%	> 203,000
Very High Efficiency	> 90%	> 203,000

Notes: (2) Supported by IES TM-21 standards. (3) Theoretical values represent estimations commonly used; however, refer to the IES position on LED Product Lifetime Prediction, IES PS-10-18, that explains proper use of IES TM-21 and LM-80.

Load Data (Stock Product)

Thd	6%
Power Factor	0.99
Weight (lbs.)	10.6
Low Temp. Start	-20°C

Shipping Data

Catalog No.	Wt.	Pallet 49"L x 52"W x 55"H
2' x 2'	12.5 lbs.	48

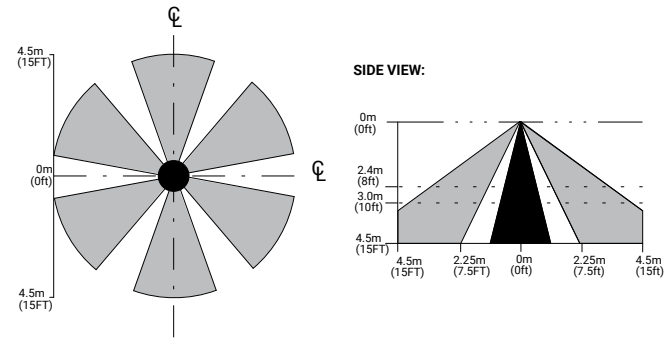
Air Return Volume

Negative Static Pressure (Inches H_2O)	Return Air Volume (CFM)
0.05	79
0.1	112
0.2	161
0.25	177
0.3	198
0.45	239

Control Systems

- WaveLinx PRO Wireless
- WaveLinx LITE Wireless
- WaveLinx Wired

Integrated Sensor Coverage Pattern



***Note**: Installation of integrated sensors within 3-ft (1m) of HVAC air vents is not recommended. The pattern shown is intended solely as a general guide and is not to scale.*

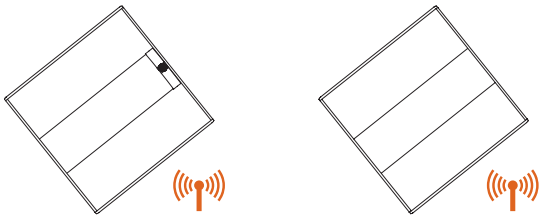
The Cruze ST with WaveLinx offers no-hassle lighting control with multiple luminaire level control solutions.

WaveLinx PRO is used for applications where spaces need to be connected to a lighting or building management system and to help building owners improve their operations, building environment, and tenants' experience by leveraging the data generated by the sensors. The WaveLinx PRO devices communicate with each other via the WaveLinx Area Controller which coordinates the data traffic between the devices, lighting apps and CORE platform. The WaveLinx Area Controller also hosts the time clock required if spaces need to be turned on/off at a specific time.

The WaveLinx PRO Sensor offers built-in occupancy and daylighting controls as well as luminaire level control including white tuning while the WaveLinx PRO Node offers luminaire level control and white tuning. If opting for the WaveLinx PRO Node option, a PRO Ceiling Sensor will most likely be needed within the space to control the lights based on occupancy and daylight levels.

WaveLinx LITE is used for single spaces where there is no need to manage the spaces remotely or exchange the sensor data with other sub-systems within the building or smart applications.

The WaveLinx LITE Sensor offers built-in occupancy and daylighting controls as well as luminaire level control.



With Integrated WaveLinx Sensor **With Integrated WaveLinx Node**

Systems comparison chart

Cooper Lighting Solutions provides many lighting system solutions designed to satisfy code requirements and meet the unique needs of any project.

Luminaire with standalone sensor

Standalone Spaces WaveLinx LITE

Networked Spaces WaveLinx PRO

Enterprise WaveLinx CORE

	Luminaire with standalone sensor	Standalone Spaces WaveLinx LITE	Networked Spaces WaveLinx PRO	Enterprise WaveLinx CORE
Occupancy	Yes	Yes	Yes	Yes
Daylighting	Yes	Yes	Yes	Yes
Wallstations	–	Yes	Yes	Yes
Gateways	–	–	1 WAC	300 WACs
Devices (MAX)	–	50 per Area (1400 per site)	200 per WAC2	32,500 per CORE Enterprise
Software	–	WaveLinx LITE Mobile App	WaveLinx Mobile App	CORE
Areas	–	28 per Site	50 per WAC2	up to 3,000
Zones	–	16 per Area	16 per Area	up to 9,000
Scheduling	–	–	Local	Global
VividTune™	–	–	Yes	Yes
Plug-Load Control	–	–	Yes	Yes
Low-Voltage Power	–	–	Yes	Yes
Integration	–	–	–	BACnet, API
Dashboards	–	–	–	Energy, Occupancy
Configuration	–	Installer	Technician	Technician / IT

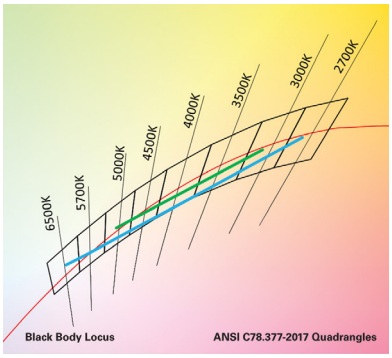
SCALABILITY

devices → areas → floors → buildings

VividTune™
color tuning solutions

22 Cruze ST LED with VividTune Tunable White

VividTune tunable white luminaires from Cooper Lighting Solutions deliver high-quality light in a broad range of continuously variable color temperatures and intensities. Create a dynamic environment by adjusting the ambient light warmer or cooler to influence mood, support the task at hand, or create a dramatic ambience. The ability to control correlated color temperature and intensity separately using simple controls is the next evolution of LED lighting for the commercial, educational, healthcare and hospitality space. The unparalleled flexibility and number of available lighting environments enable users to find the right light with tunable white.



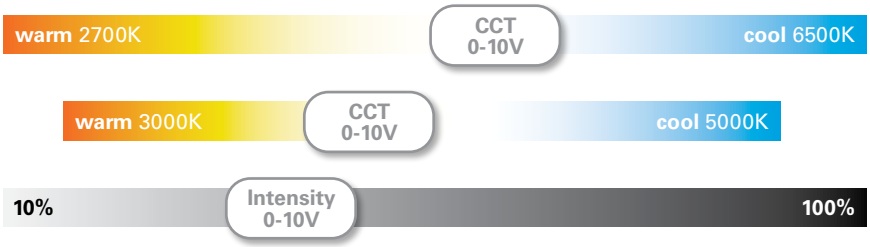
Performance Data*

Tunable White - Lumen Adjustment Factors				
CCT	3000K-5000K		2700K-6500K	
	80 CRI	90 CRI	80 CRI	90 CRI
2700K	-	-	0.868	0.741
3000K	0.894	0.736	0.893	0.771
3500K	0.946	0.804	0.924	0.809
4000K	0.993	0.868	0.944	0.835
4500K	1.002	0.883	0.961	0.857
5000K	1.002	0.883	0.974	0.874
6500K	-	-	0.988	0.897

2' x 2' Cruze ST LED - Example of Approximate Lumen Calculation			
	Standard Catalog #	VividTune 80 CRI Catalog #	VividTune 90 CRI Catalog #
CCT Setting	22CZ2-34HE-UNV-L835-CD1-U	22CZ2-34HE-UNV-L83050-W2A1-U	22CZ2-34HE-UNV-L93050-W2A1-U
3000K	-	3026	2491
3500K	3386	3202	2722
4000K	-	3362	2940
4500K	-	3394	2991
5000K	-	3394	2991

Controlling VividTune Tunable White

VividTune luminaires make tunable white more accessible by using simple and familiar controls. From wall dimmers to wireless controls, VividTune tunable white luminaires are compatible with industry standard 0-10V dimming controls. A single 0-10V dimming input is used to control intensity (brightness) while a second 0-10V dimming input is used to adjust CCT. For suggested control configurations, go to www.cooperlighting.com for tunable white application guides.



Example of Lumen Adjustment Calculation

22CZ2-34HE-UNV-L83050-W2A1-U
at 80 CRI tuned to 3500K

Adjusted Lumen =
published lm x adjusted lm factor

Adjusted Lumen = 3386 x 0.946

Adjusted Lumen = 3202 lm

** Lumen adjustment factors are for reference and may be different for each product selected. Refer to IES files for actual performance data on each.*

Cooper Lighting Solutions
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

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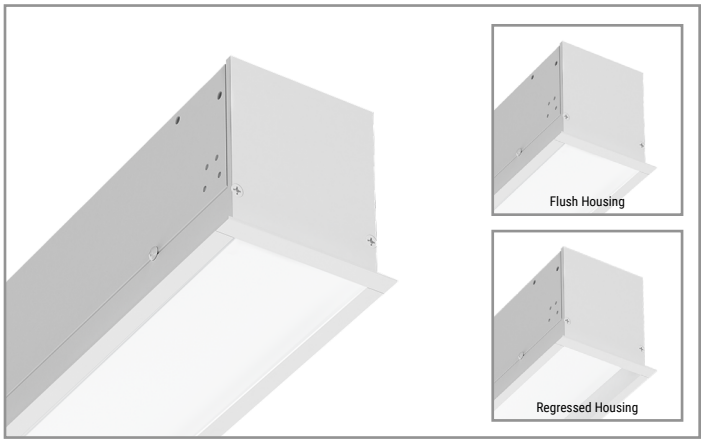
Specifications and dimensions subject to change without notice.

Project		**Catalog #**		**Type**	
Prepared by		**Notes**		**Date**	



Neo-Ray

Define 4

LED
Recessed
Direct

Typical Applications

Office • Education • Healthcare • Hospitality • Retail

Interactive Menu

- Order Information page 2
- Shielding Options page 3
- Photometric Data page 4
- Integrated Sensor Details page 6
- VividTune page 7

Product Certification

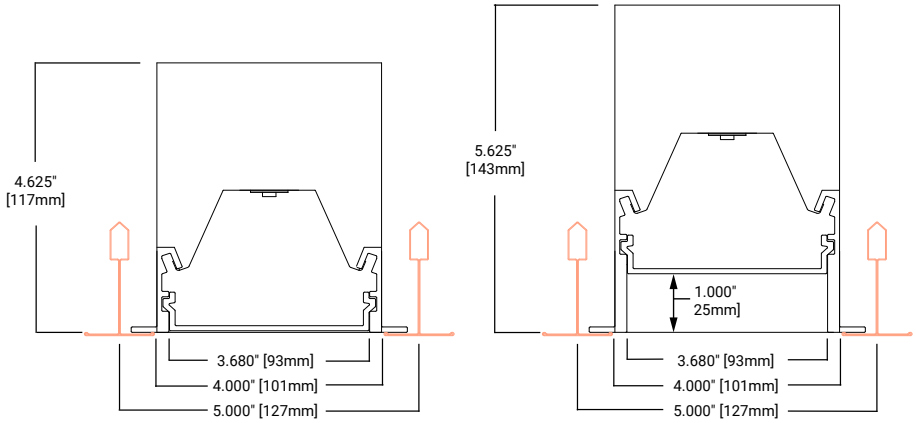
Product Features

VividTune

Top Product Features

- Specifiable to the nearest 1" in length
- Satin Lens, Asymmetric Lens and Drop Lens available
- Flush and Regressed Housing
- Customizable lumen packages
- Precision extended trims fit a variety of different architectural ceiling types
- Industry leading performance and efficacy
- Standard and custom corners / transitions available
- Options to meet Buy American Act requirements

Dimensions



S124DR
Flush Housing

S124RDR
Regressed Housing

additional product diagrams

Order Information

Icon Key: Grey bar denotes available with 10-Day Quick Ship
Ø Consult factory for availability

SAMPLE ORDER NUMBER: **S124DR-S795D840-ETG4F0-1B1-UDD-F-W-SWPD1**

Domestic Preference	Light Distribution	Light Engine	Lumen Package Down	CRI	LED CCT	Ceiling Type	Length	Circuiting
[Blank]=Standard **BAA**=Buy American Act	**S124DR**=Define 4 Direct Recessed **S124RDR**=Define 4 Regressed Direct Recessed **QS-S124DR**=Define 4 Direct Recessed Quick Ship	**-S**=Standard **-H**=High Performance **-V**=VividTune	**350D**=350 Lms/ft **575D**=575 Lms/ft **795D**=795 Lms/ft **1020D**=1020 Lms/ft **1195D**=1195 Lms/ft **____D**=Custom Lms/ft	**8**=80 **9**=90	**27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K **2765**=2700K-6500K **3050**=3000K-5000K	**-ETG**=15/16" T-Grid **-FTG**=9/16" T-Grid **-STG**=9/16" Slot T-Grid **-FTT**=9/16" Tegular T-Grid **-ITG**=9/16" Interlude T-Grid **-ETT**=15/16" Tegular T-Grid **-GYP**=Gypsum board **-FSR**=Mud-in Gypsum Board **-FES**="Finished" Extruded Side	**2F0**=2' Individual **4F0**=4' Individual **8F0**=8' Individual **12F0**=12' Individual **__F0**=4' Incremental Run (e.g. 40F0 = 40' 0") **__F_**=1" Incremental Run (e.g. 21F3 = 21' 3")	**-1**=Single Circuit **-S**=Secondary Circuit
Notes Only product configurations with this designated prefix are built to be compliant with the Buy American Act of 1933 (BAA). Please refer to Domestic Preferences website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.	**Notes** RDR regress of 1" will add an additional 1" to fixture depth.	**Notes** See performance table for add'l details. Light engine must be consistent across run length.	**Notes** 3500K/80CRI/DR housing/F Lens. Please refer to scaling data for other variables. For custom lumen output, please refer to additional information on page 4. VividTune available with 795D, 1020D, and 1195D.	**Notes** Additional lead-time and cost may apply for 927, 930, 935 and 940 configurations. 2700K not available in 80CRI. 2765 & 3050 VividTune configurations require V light engine, 90 CRI, and W2A driver.		**Notes** Please refer to ceiling interface diagrams for additional detail and dimensions.	**Notes**	**Notes** Secondary circuit similar to A/B switching. Price adder applies for "S" configuration. VividTune Secondary Circuit has shared CCT wiring.

Emergency	Voltage	Integral LED Driver	Shielding Down	Options	Color	Integrated Sensor
E=Emergency circuit **B1**=Surelite 7W UNV integral battery **B2**=Surelite 14W UNV integral battery **B3**=Bodine 6W UNV Integral **T**=UL924 EPC Emergency Bypass Relay	**-U**=UNV 120-277V **-1**=120V **-2**=277V **-3**=347V **-4**=48VDC Ø	**DD**=0-10 Volt Dimming, 1% **5L**=DALI Dimming, 5%-100% **LH**=Lutron LDE1 w/ecosys **LV1**=DLVP Ø **W2A**=White Tuning, 0-10V Dimming (VividTune only)	**-F**=Satin Flush Diffuser **-A**=Asym Flush Optic **-D**=Satin Drop Diffuser **-L**=Straight blade louver with diffuser Ø	**-CP**=Chicago Plenum **-R**=GLR Fuse (Fast) **-F**=GMF Fuse (Slow)	**-W**=Matte White **-S**=Silver **-B**=Black **-C**=Custom Color Ø	**-WAA**=WaveLinx Pro Integral **-WTA**=WaveLinx Pro Tilemount **-WAB**=WaveLinx Lite Integral Ø **-WTB**=WaveLinx Lite Tilemount Ø **-LWIPD1**=Enlighted Integral **-LWTPD1**=Enlighted Tilemount **-SVPD1**=Standalone Sensor **-SVTPD1**=Standalone Sensor Tilemount
Notes Internal battery standard for fixtures ≥ 4ft and lumen output ≤1195 Lms/ft. Fixture Non-IC-Rated for internal battery and lumen output ≥1020 Lms/ft. External battery standard with fixtures <4ft and all Chicago plenum fixtures.	**Notes** 48V for use with LV1 driver. 347V only available with DD driver.	**Notes** DD driver is standard. For non-dimming applications, the driver will default to full brightness if no connection is made to the capped dimming wires in the field.	**Notes** All lensing options are snap-in lenses. "L" option required RDR housing and may require additional lead-time, please consult factory for details. A option not available with VividTune.	**Notes**	**Notes**	**Notes** Please refer to page 6 for additional detail required to specify integrated or tile-mount sensors. Integral option not available with regressed, drop or asymmetric configurations. Tilemount configuration recommended for these applications.

Product Specifications

Construction
- Available in Flush and Regressed Housing
- Precision cut housing trim extruded from 6063 aluminum with aluminum frame
- Extruded end-caps ensure a precise and uniform ceiling interface
- Nominal 2' -12' illuminated sections used in run configuration and/or individual fixtures

Finish
- Electrostatically applied polyester powder coat paint

LED Module
- Modular LED tray assembly comprising reflector, light engine, led driver and quick disconnect wire-harness for ease of installation and maintenance over the life of the luminaire

Light Engine
- Offered with three next generation Neo-Ray light engines delivering industry leading efficacy and long-life
- LED's are available in 2700K, 3000K, 3500K, 4000K or VividTune ranges of 2700K-6500K and 3000K-5000K
- CRI options of either ≥80CRI or ≥90CRI (Lumen output will be affected - please refer to the lumen adjustment factor table)

LED Drivers
- LED system coupled with electrical driver
- Traditional electronic drivers are available for 120-277V and 347V applications
- Cooper Lighting Solutions's DLVP Low voltage drivers are available for 48VDC applications

Controls and Integrated Sensors
- Equipped standard with a 0-10V continuous dimming driver. Compatible with most standard dimming devices
- Additional control types are available (DALI, Lutron, DLVP) at an additional cost
- WaveLinx and Enlighted wireless sensors as well as stand-alone sensors available

Mounting
- Recessed

Lengths
- Available in any length (23" min) with a resolution of 1 inch. Max section length of 12ft (8ft max option available)
- Additional fixture lengths are available please consult factory. All lengths are nominal
- VividTune available as standard product in 1ft resolution
- Actual sizes are one inch shorter than nominal to allow easy in-grid installation
- For Gypsum or Flangeless installations add 1 inch to overall fixture length (e.g. 4F1 for 48" length)
- Refer to ceiling type section of specification sheet and submittal drawings for actual sizes

Corners and Transition Pieces
- Corners and other transition pieces are fully luminous
- Constructed using precision mitered frame and lens components
- The frame is welded to ensure a precise and robust assembly
- Standard 90° horizontal and vertical corners as well as custom corners are available
- Consult corner and pattern addendum for additional information
- Alternative transition pieces such as T's, Y's, X's, etc. are also available ∅

Snap-In lensing Options
- Satin Flush - Flush, high diffusion glare-free lens
- Satin Drop - 1" Drop, high diffusion glare-free lens
- Asymmetric - Flush, low-glare Asymmetric lens
- Flush options ship with our patent-pending underlens solution, the proud lens ships with an injection molded end cap to eliminate light leak

Reflectors
- Precision formed cold-rolled steel reflectors with high reflectivity
- Ultra high reflectivity used with High Performance light engine

Lumen Maintenance
- 90% (L90) of initial light output at 100,000+ hrs
- 70% (L70) of initial light output at 400,000+ hrs
- Derived from TM-21 standard @25°C ambient and typical operating conditions

Custom Lumen Output
- Custom lumen output expressed option in Lumens per foot (e.g. -725D for 725 Lms/ft down). Refer to additional detail on page 4.

Electrical
- Dimming provided as standard
- Dimming wires capped with wire-nuts for non-dimming applications
- Optional battery backup options provided
- Default battery location is internal to fixture
- Default emergency section is 4ft in length and located at the beginning of the fixture unless designated elsewhere
- Estimated lumen output = battery wattage * min efficacy (see performance table)
- Estimate lumen output from the emergency section, multiply battery wattage x minimum fixture efficacy
- The EPC option will bypass local controls and dimming upon loss of normal power. This option is required when the fixture has both integrated sensors and emergency circuiting

Integrated Sensors
- Please reference page 6 for details

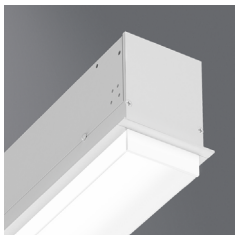
Weight
- 2.65 lbs per foot

Approvals
- cULus - listed for damp locations
- RoHS compliant
- Meets NYC requirements
- Meets CCEC requirements
- IC Rated for insulation contact (except where noted)
- Tested to IESNA LM-79 and LM-80
- Can be used for State of California Title 24 high efficacy luminaire
- DesignLights Consortium® Qualified and classified for both DLC Standard and DLC Premium, refer to www.designlights.org for details

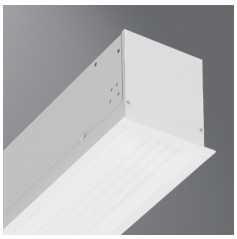
Warranty
- Five year warranty standard.

Shielding Options

S124DR with Flush Satin Lens (F)



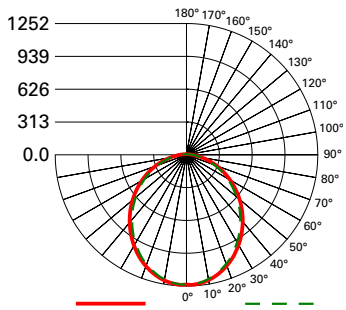
S124DR with Drop Satin Lens (D)



S124DR with Flush Asymmetric Lens (A)

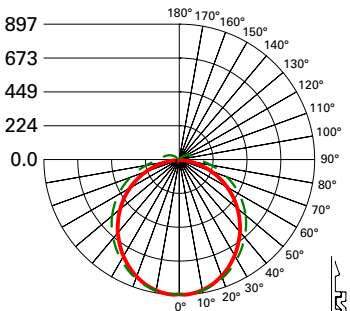
Photometric Data

View IES files



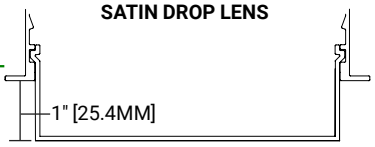
FILE NAME: S124DR-S795D835-GYP4F0-1-UDD-F-W
LUMENS: 3203 Lms
LPW: 121.3 LPW
CCT: 3500K
WATTS: 26.2 W
TEST NUMBER: G3-1802-639-5

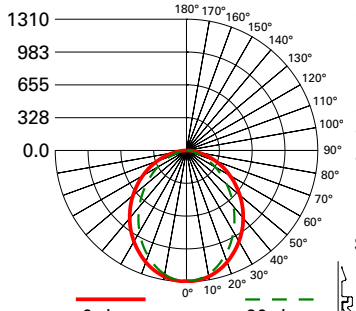
SATIN FLUSH LENS



FILE NAME: S124DR-S795D835-GYP4F0-1-UDD-D-W
LUMENS: 3045 Lms
LPW: 115.3 LPW
CCT: 3500K
WATTS: 26.4 W
TEST NUMBER: G3-1802-639-16

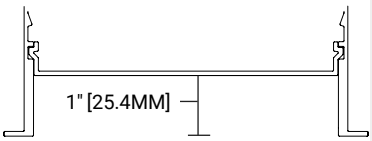
SATIN DROP LENS

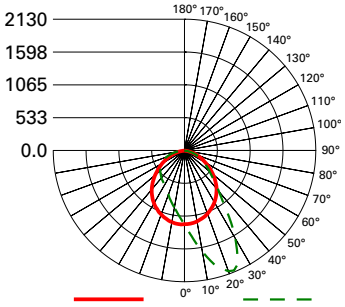




FILE NAME: S124RDR-S795D835-GYP4F0-1-UDD-F-W
LUMENS: 3018 Lms
LPW: 114.3 LPW
CCT: 3500K
WATTS: 26.4 W
TEST NUMBER: G3-1802-639-26

SATIN REGRESSED DIFFUSER





FILE NAME: S124DR-S795D835-GYP4F0-1-UDD-A-W
LUMENS: 3331 Lms
LPW: 126.2 LPW
CCT: 3500K
WATTS: 26.4 W
TEST NUMBER: G3-1802-639-21

ASYMMETRIC FLUSH LENS

Photometric Overview and Performance Data

Performance Per Linear Foot at 3500K/80CRI

Nominal Output	Standard and VividTune Light Engine		High Performance Light Engine	
lms/ft	W/ft	lm/W	W/ft	lm/W
350	3.0	121	2.9	126
575	4.8	123	4.4	133
795	6.8	121	6.1	133
1020	8.9	118	8.1	130
1195	10.6	115	9.7	126

Lumen Adjustment Factors

CCT	80CRI	90CRI
2700K	N/A	0.801
3000K	0.943	0.815
3500K	1.000	0.861
4000K	1.010	0.892

LUMEN ADJUSTMENT CALCULATIONS

Example 1 - Adjusted Lumen Output
Nominal Lumen Output selected = 1025 lms/ft (based on standard of 3500K/80CRI)
Lumen Adjustment Factor = 0.801 (2700K/90CRI desired)

Adjusted Lumen Output = Nominal Lumen Output x Lumen Adjustment Factor
Adjusted Lumen Output = 1025 lms/ft x 0.801 = 821 lms/ft

Example 2 - Custom Lumen Output based on Required Lumens Per Foot
Total light output (4ft) requirement of 2800 lms, desired CCT and CRI of 4000K/80CRI

Total required lumens per foot @ 4000K= 2800 lms / 4 ft = 700 lms/ft
Lumen Adjustment Factor = 1.018 (Requirement based on 4000K / 80CRI)

Total required lumens per foot @ 3500K / 80CRI = 700 lms/ft ÷ 1.018 = 688 lms/ft

Estimated efficacy = 121 lm/W (find nearest value using table above)
Estimated power consumption = 688 lms/ft ÷ 121 lm/W = 5.69 W/ft

Custom Lumen Output

Total Light Output Range (lms/ft)

CCT	80CRI	90CRI
2700K	N/A	189-1058
3000K	222-1246	192-1077
3500K	236-1321	203-1138
4000K	238-1335	210-1179

If your requirement is expressed in power consumption (W/ft) rather than light output, you can use the power to lumen output curves to convert power consumption to light output for specification.

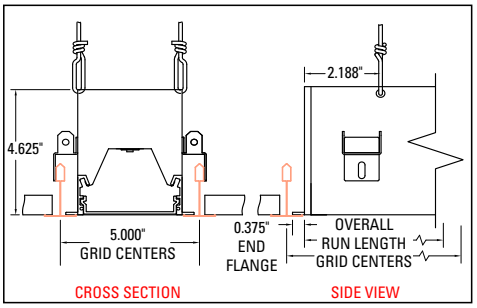
Efficacy for custom lumen outputs can be estimated using lumen output curves or with the use of our online custom lumen output tool.

Ceiling Type

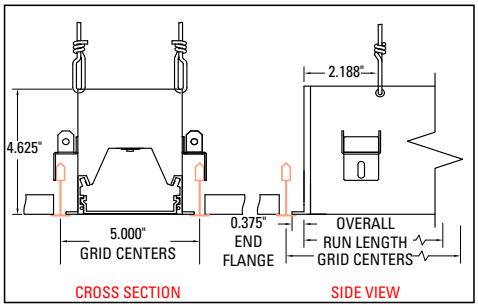
Extruded Trim Flange Details - Refer to submittal drawings for detailed flange information - for additional options consult factory.

Grid Ceiling Systems

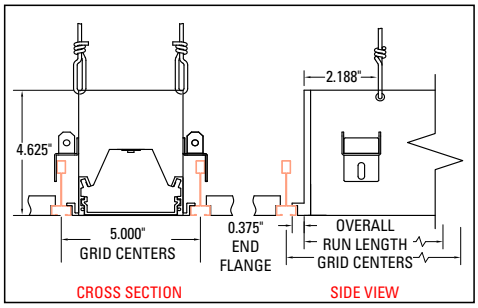
15/16 Tee (ETG)



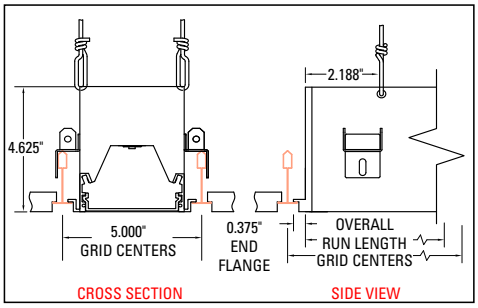
9/16 Tee (FTG)



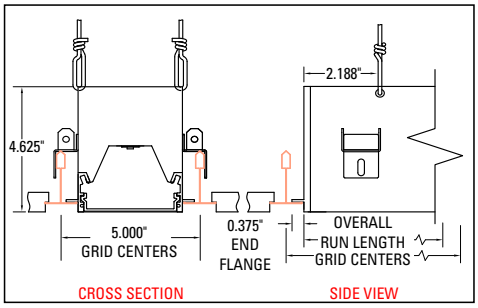
9/16 Slotted Tee (STG)



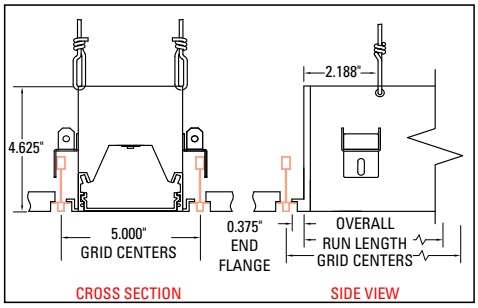
9/16 Tegular (FTT)



15/16 Tegular (ETT)

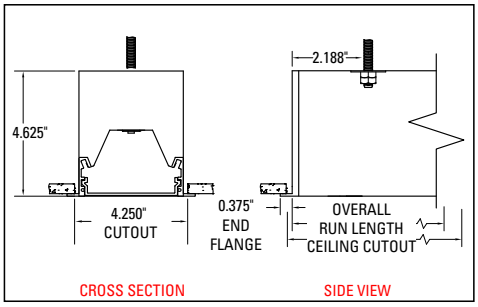


9/16 Interlude Tee (ITG)

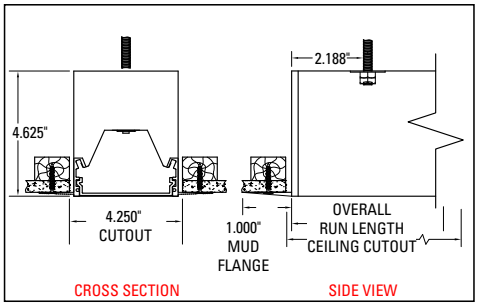


Drywall Ceiling

Visible Flange (GYP)



Mud-In Flange (FSR)



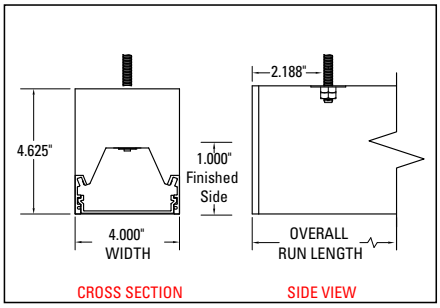
NOTE: ACTUAL LENGTH OF GYP/FSR FIXURES WILL BE 1" SHORTER IN LENGTH THAN TOTAL REQUESTED RUN LENGTH FOR ALL RECESSED / PERIMETER FIXTURES

OVERALL RUN LENGTH = 'FIXTURE ORDER LENGTH' - 1" E.G. - OVERALL RUN LENGTH OF 3' 11" WILL SHIP WHEN ORDERING A '4F0' FIXTURE

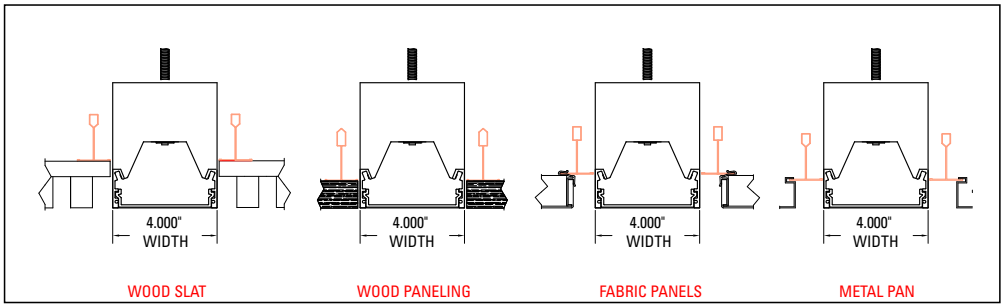
CEILING CUTOUT = 'OVERALL RUN LENGTH' + 0.250" OR CEILING CUTOUT = 'FIXTURE ORDER LENGTH' - 0.750" E.G. - CEILING CUTOUT WHEN ORDERING A '4F0' LENGTH FIXTURE WILL BE 3' 11.250"

Other Ceiling Systems (Wood, Fabric, Metal Pan, HD Box Style)

Finished Extruded Side (FES)



Typical Installations using Finished Extruded Side (FES)



Integrated Sensor Details and Placement

Sensor Type	Wireless	Sensor Integration	Sensor Mounting	Ordering Code
WaveLinx Pro	Yes	Integral to Fixture	Mounted in solid cover	WAA
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	WTA
WaveLinx Lite	Yes	Integral to Fixture	Mounted in solid cover	WAB
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	WTB
Enlighted	Yes	Integral to Fixture	Mounted in illuminated lens	LWIPD1
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	LWTPD1
Stand-Alone SVPD1	No	Integral to Fixture	Mounted in solid cover	SVPD1
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	SVTPD1

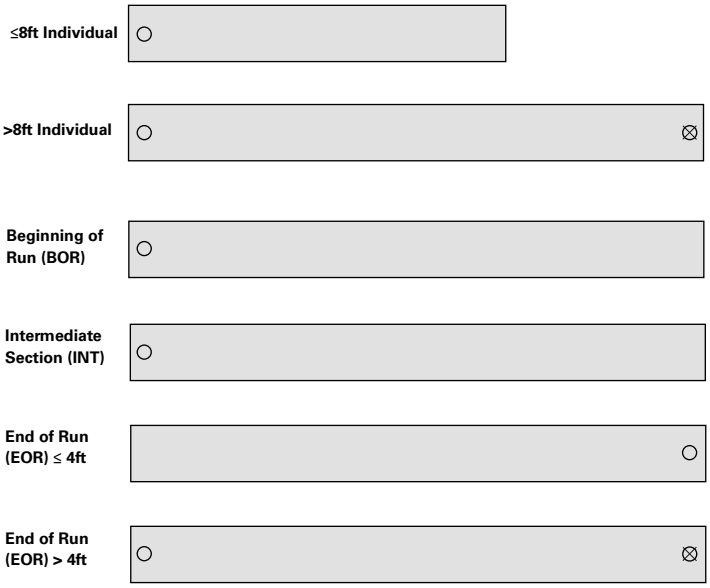
○ Standard Sensor with Luminaire Control
⊠ Auxiliary Sensor used for Sensor Coverage (wireless systems only)

Optional standalone and wireless connected integrated sensors require use of the DD (0-10V) driver. WaveLinx Pro and Enlighted sensors require additional system hardware (not provided) for full functionality. Tilemount sensor recommended for optimal sensor coverage on perimeter applications. Tilemount sensor not available with Chicago plenum option.

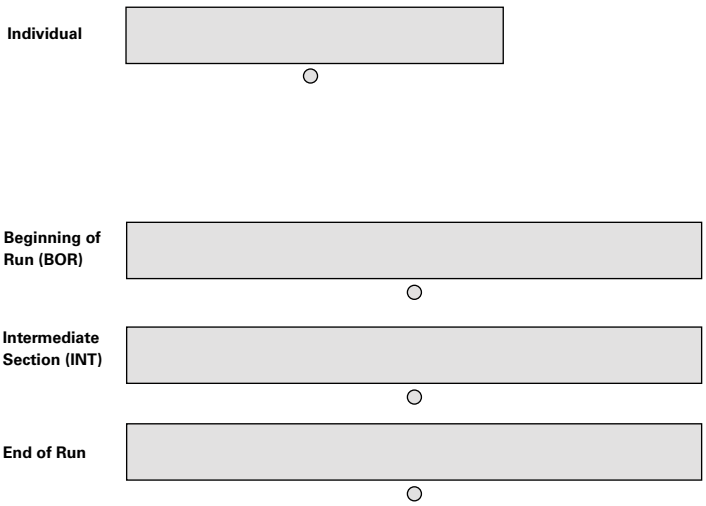
Standard sensor layout is shown below. Please refer to sensor coverage pattern diagrams to ensure proper coverage for the application. Standard configurations are available in both individual fixtures and in continuous runs. For optimal coverage, continuous runs will default to 8ft max section length.

For additional information integrated sensors and connected lighting, please visit Cooper Lighting Solutions's Connected Lighting Website.

INTEGRAL SENSOR



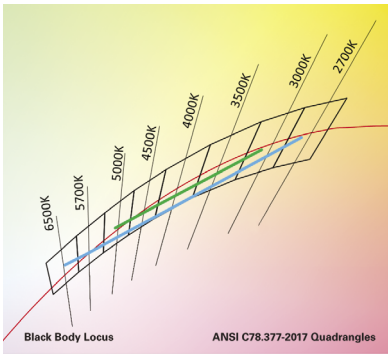
TILEMOUNT SENSOR (OPTIMAL LOCATION)



VividTune™
color tuning solutions

Define 4 LED Recessed with VividTune Tunable White

VividTune tunable white luminaires deliver high-quality light in a broad range of continuously variable color temperatures and intensities. Create a dynamic environment by adjusting the ambient light warmer or cooler to influence mood, support the task at hand, or create a dramatic ambience. The ability to control correlated color temperature and intensity separately using simple controls is the next evolution of LED lighting for the commercial, educational, healthcare and hospitality space. The unparalleled flexibility and number of available lighting environments enable users to find the right light with tunable white.



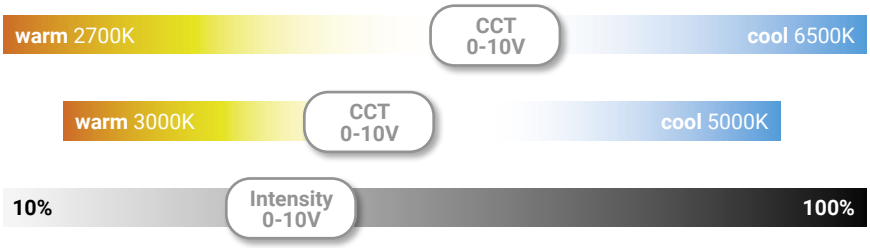
Performance Data*

Tunable White - Lumen Adjustment Factors				
CCT	3000K-5000K		2700K-6500K	
	80 CRI	90 CRI	80 CRI	90 CRI
2700K	-	-	0.868	0.741
3000K	0.894	0.736	0.893	0.771
3500K	0.946	0.804	0.924	0.809
4000K	0.993	0.868	0.944	0.835
4500K	1.002	0.883	0.961	0.857
5000K	1.002	0.883	0.974	0.874
6500K	-	-	0.988	0.897

Example of Approximate Lumen Calculation			
	Standard Catalog #	VividTune 80 CRI Catalog #	VividTune 90 CRI Catalog #
CCT Setting	S124DR-C1020D835-X-UDD-F-W	S124DR-V1020D83050-X-UW2A-F-W	S124DR-V1020D93050-X-UW2A-F-W
3000K	-	3648	3003
3500K	4080	3860	3280
4000K	-	4051	3541
4500K	-	4088	3603
5000K	-	4088	3603

Controlling VividTune Tunable White

VividTune luminaires make tunable white more accessible by using simple and familiar controls. From wall dimmers to wireless controls, VividTune tunable white luminaires are compatible with industry standard 0-10V dimming controls. A single 0-10V dimming input is used to control intensity (brightness) while a second 0-10V dimming input is used to adjust CCT. For suggested control configurations, go to www.cooperlightingsolutions.com for tunable white application guides.



Example of Lumen Adjustment Calculation

S124DR-V1020D83050-X-UW2A-F-W
at 80 CRI tuned to 3500K

Adjusted Lumen =
published lm x adjusted lm factor

Adjusted Lumen = 4080 x 0.946

Adjusted Lumen = 3860 lm

* Lumen adjustment factors are for reference and may be different for each product selected. Refer to IES files for actual performance data on each.

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www.cooperlighting.com

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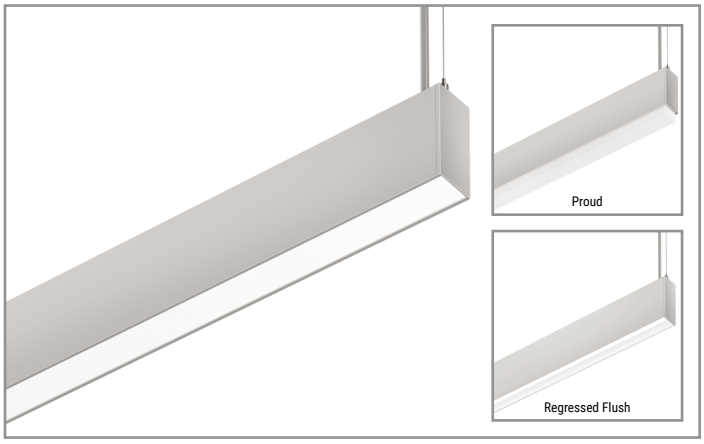
Specifications and dimensions subject to change without notice.

TYPE F

Project		Catalog #		Type	
Prepared by		Notes		Date	



Neo-Ray

Define 2

2" LED
Suspended Pendant
Direct

Typical Applications

Office • Education • Healthcare • Hospitality • Retail

Interactive Menu

- Order Information page 2
- Product Specification page 3
- Photometric Data page 4
- Performance Data page 5
- VividTune page 6

Product Certification

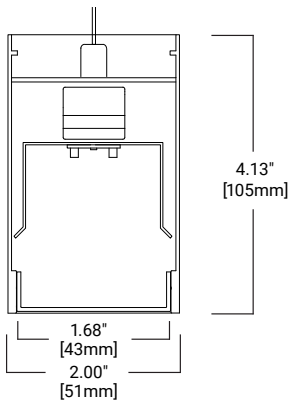
Product Features

damp location · powered by fifthlight · VividTune · QS

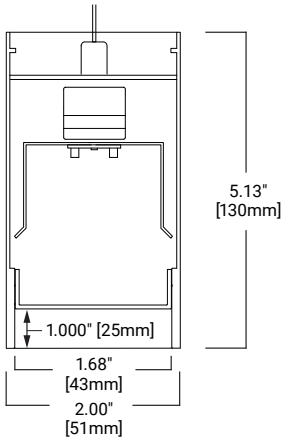
Top Product Features

- Suspended Slot family in 2", 3", 4" and 5" housing sizes
- Specifiable to the nearest foot
- Satin, Asymmetric and Drop Direct Lensing available
- Independently specifiable Direct / Indirect lumen packages
- 0-10V dimming standard; DALI dimming available
- 2700K, 3000K, 3500K, 4000K, and 5000K correlated color temperatures available
- Options to meet Buy American Act requirements

Dimensional and Mounting Details



Standard Housing



Regressed Housing

additional product diagrams

Order Information

Icon Key: Grey bar denotes available with 10-Day Quick Ship
Ø Consult factory for availability

SAMPLE ORDER NUMBER: **S122DP-C675D835-C4JB4F0-1T-UDD-F-W-SWPD1**

Domestic Preference	Series	Light Engine	Lumen Package Down (Lms/ft)	CRI	LED CCT	Suspension Type	Ceiling Type	Mounting HW Color
[Blank]=Standard **BAA**=Buy American Act	**QS-S122DP**=Define 2 Direct Pendant Quick Ship **S122DP**=Define 2 Direct Pendant **S122RDP**=Define 2 Regressed Direct Pendant	**-C**=Core **-H**=High Performance **-V**=VividTune Ø	**290D**=290 Lms/ft (2.9W/ft) **485D**=485 Lms/ft (4.8W/ft) **675D**=675 Lms/ft (6.7W/ft) **865D**=865 Lms/ft (8.8W/ft) **1005D**=1005 Lms/ft (10.6W) **____D**=Custom Lms/ft Ø	**8**=80 **9**=90	**27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K **2765**=2700K-6500K **3050**=3000K-5000K	**-C4**=4ft Aircraft Cable **-C10**=10ft Aircraft Cable **-C20**=20ft Aircraft Cable **-S4**=4ft Stem Mount **-S8**=8ft Stem Mount	**JB**=Gypsum Board, Junction Box, Structure **T1**=15/16" T-Grid (ETG) **T9**=9/16" T-Grid (FTG) **TS**=9/16" Slot (STG), Tegular (FTT), Interlude (ITG)	**(blank)**=White **B**=Black
Notes Only product configurations with this designated prefix are built to be compliant with the Buy American Act of 1933 (BAA). Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.	**Notes** RDP regress of 1" will add an additional 1" to fixture depth.	**Notes** See performance table for add'l details. Light engine must be consistent across run length. V option requires lumen package of 675 lms/ft or greater.	**Notes** 3500K/80CRI/DIP/F Lens. Please refer to scaling data for other variables. For custom lumen output, please refer to additional information on page 3. 290 Lms/ft not available on 2ft fixture length.	**Notes** Additional lead-time and cost may apply for 927, 930, 935 and 940 configurations. 2765/3050 VividTune configurations require V light engine and W2A driver.		**Notes**	**Notes**	**Notes** White mounting hardware standard

Luminaire Length (Ft)	Max section length	Circuiting	Additional Section Wiring	Voltage	Driver Type	Shielding Down
2**F0**= 2' Nominal Length 4**F0**=4' Nominal Length 8**F0**=8' Nominal Length **___F0**=4' Incremental Run (e.g. 40F0 = 40' 0") **___F0**=1' Incremental Run (e.g. 39F0 = 39' 0")	**(blank)**=12ft (std) **/8**=8ft	**-1**=Single Circuit **-S**=Secondary Circuit	**E**=Emergency Circuit **B3**=Bodine 6W UNV Integral **T**=UL924 EPC Emergency Bypass Relay	**-U**=Universal (120V-277V) **-1**=120V **-2**=277V **-3**=347V	**DD**=Standard 0-10V Dimming (1%-100%) **5L**=Fifth Light DALI (5%-100%) **L5**=Lutron 5 Series (LDE5-Series) 5%-100% EcoSys **LH**=Lutron HiLume (LDE1 series) 1%-100% EcoSys **W2A**=White Tuning, 0-10V Dimming (VividTune only)	**-F**=Satin White Diffuser **-D**=Satin Drop diffuser **-A**=Asymmetric Diffuser **-L**=Straight Blade Diffuser w/ diffuser Ø
Notes Minimum fixture length is 2ft. Specify to nearest foot in length.	**Notes** Individual fixtures configured as 12ft max by default. Continuous runs configured as 8ft max (12ft not available).	**Notes** Secondary circuit similar to A/B switching. Price adder applies for "S" configuration.	**Notes** Battery available on fixture ≥ 4ft in length. B3 and T options not compatible with 347V. Standard battery 4ft battery section located in the beginning of the fixture, but can be relocated using the linear product configurator.	**Notes** 347V only available with DD driver option.	**Notes** DD driver is standard. For non-dimming applications, the driver will default to full brightness if no connection is made to the capped dimming wires in the field.	**Notes** All lensing options are snap-in lenses. "L" option required RDP series and will require additional lead-time, please consult factory for details.

Options	Finish	Integrated Sensor
-R=GLR Fuse (Fast) **-F**=GMF Fuse (Slow)	**-W**=White **-S**=Silver **-B**=Black **-C**=Custom Match **-R**=RAL Custom	**-WAA**=WaveLinx Pro Wireless **-WAB**=WaveLinx Lite Wireless Ø **-LWIPD1**=Enlighted Wireless **-SVPD1**=Standalone **(Blank)**=None
Notes Additional lead-time may apply. Not available with 347V option.	**Notes** Contact factory for C and R options. W/S/B are standard.	**Notes** DD driver must be selected. Please refer to page 5 for additional detail required to specify integrated sensors. Integral option not available with regressed or drop lensing.

Product Specifications

Construction
- Available in Flush and Regressed Housing
- Precision cut housing extruded from 6063 aluminum
- Precision cut & welded end-caps ensure a robust and clean construction
- Nominal 2' -12' illuminated sections used in individual fixtures and 2'-8' illuminated sections used in continuous runs

Finish
- Electrostatically applied polyester powder coat paint

LED Module
- Modular LED tray assembly comprising reflector and light engine with quick disconnect wire-harness for ease of installation and maintenance over the life of the luminaire

Light Engine
- Offered with two next generation Neo-Ray light engines delivering industry leading efficacy and long-life
- LED's are available in 2700K, 3000K, 3500K, 4000K or 5000K
- CRI options of either ≥80CRI or ≥90CRI (Lumen output will be affected - please refer to the lumen adjustment factor table)

LED Drivers
- LED system coupled with electrical driver
- Traditional electronic drivers are available for 120-277V and 347V applications

Controls and Integrated Sensors
- Equipped standard with a 0-10V continuous dimming driver. Compatible with most standard dimming devices
- Additional control types are available (DALI & Lutron) at an additional cost
- WaveLinx and Enlighted wireless sensors as well as stand-alone sensors available

Mounting
- Suspended

Lengths
- Available in any length (2ft min) with a resolution of 1 foot. Max section length of 12ft (8ft max used on continuous runs and available for individual fixtures)
- Additional fixture lengths are available please consult factory. All lengths are nominal and do not include end caps.

Corners and Transition Pieces
- Corners and other transition pieces are fully luminous
- Constructed using precision mitered housing and lens components
- Extrusions are welded to ensure a precise and robust assembly
- Standard 90° horizontal corners as well as custom corners are available
- Consult online linear configurator or the factory for precise corner locations and for ordering
- Alternative transition pieces such as T's, Y's, X's, etc. are also available Ø

Direct Snap-In lensing Options
- Satin Flush - Flush, high diffusion glare-free lens
- Satin Drop - 1" Drop, high diffusion glare-free lens
- Asymmetric - Flush, low-glare Asymmetric lens
- Flush options ship with our patent-pending underlens solution, the proud lens ships with an injection molded end cap to eliminate light leak

Reflectors
- Precision formed cold-rolled steel reflectors with high reflectivity
- Ultra high reflectivity used with High Performance light engine

Lumen Maintenance
- 90% (L90) of initial light output at 61,000+ hrs
- 70% (L70) of initial light output at 237,000+ hrs
- Derived from TM-21 standard @25°C for worst case operating conditions

Custom Lumen Output
- Custom lumen output expressed option in Lumens per foot (e.g. -725D for 725 Lms/ft down). Refer to additional detail on page 4.

Electrical
- Dimming provided as standard
- Dimming wires capped with wire-nuts for non-dimming applications
- Optional battery backup options provided
- Default battery location is internal to fixture
- Default emergency section is 4ft in length and located at the beginning of the fixture unless designated elsewhere
- Estimated lumen output = battery wattage * min efficacy (see performance table)
- The EPC option will bypass local controls and dimming upon loss of normal power. This option is required when the fixture has both integrated sensors and emergency circuiting

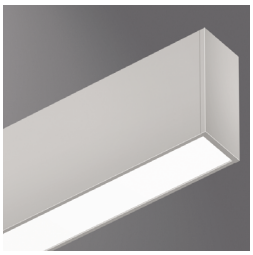
Integrated Sensors
- Please reference page 5 for details

Weight
- 3.0 lbs per foot

Approvals
- cULus - listed for damp locations
- Meets NYC requirements
- Meets CCEC requirements
- Tested to IESNA LM-79 and LM-80
- Can be used for State of California Title 24 high efficacy luminaire
- DesignLights Consortium® Qualified and classified for DLC Standard refer to www.designlights.org for details and listed configurations.

Warranty
- Five year warranty standard.

Shielding Options



Standard Flush Lens

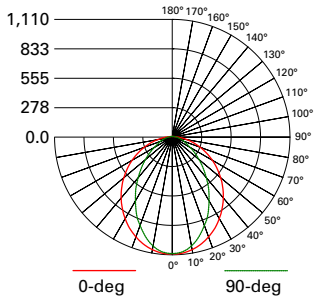
Regressed Flush Lens

Standard Proud Lens

Asymmetric Lens

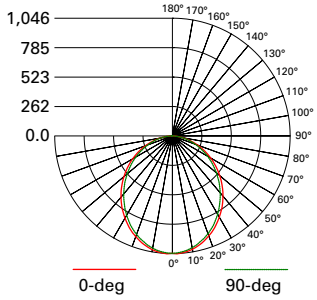
Photometric Data

View IES files

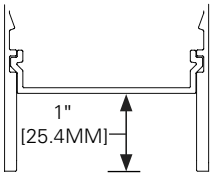


FILE NAME:
S122RDP-S675D835-4F0-1E-UDD-F
LUMENS: 2272.6 Lms
LPW: 86.4 LPW
CCT: 3500K
WATTS: 26.3 W
TEST NUMBER: P333887

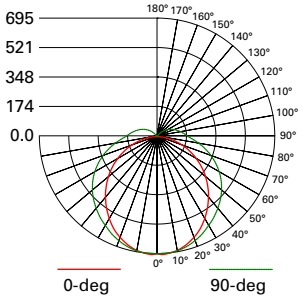
SATIN FLUSH LENS



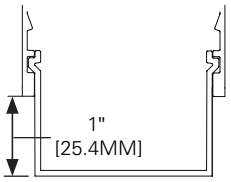
FILE NAME:
S122DP-S675D835-4F0-1E-UDD-F
LUMENS: 2645.9 Lms
LPW: 100.6 LPW
CCT: 3500K
WATTS: 26.3 W
TEST NUMBER: P333817



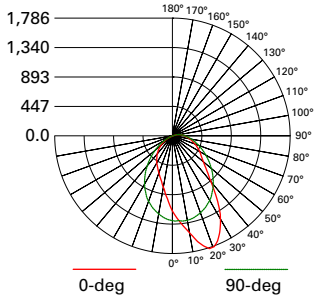
SATIN REGRESSED DIFFUSER



FILE NAME:
S122DP-S675D835-4F0-1E-UDD-D
LUMENS: 2632.8 Lms
LPW: 100.1 LPW
CCT: 3500K
WATTS: 26.3 W
TEST NUMBER: P333782



SATIN DROP LENS



FILE NAME:
S122DP-S675D835-4F0-1E-UDD-A
LUMENS: 2870.4 Lms
LPW: 109.1 LPW
CCT: 3500K
WATTS: 26.3 W
TEST NUMBER: P333747

ASYMMETRIC FLUSH LENS

Photometric Overview and Performance Data

Direct Performance Per Linear Foot at 3500K/80CRI

Nominal Output	Standard		High Performance		VividTune	
lms/ft	W/ft	lm/W	W/ft	lm/W	W/ft	lm/W
290	2.9	105	2.9	108	3	102
485	4.8	106	4.4	111	4.9	103
675	6.7	104	6.1	111	6.7	102
865	8.8	102	8.1	109	8.9	99
1005	10.6	98	9.7	105	10.7	96

LUMEN ADJUSTMENT CALCULATIONS
Example 1 - Adjusted Lumen Output
Nominal Lumen Output selected = 1025 lms/ft (based on standard of 3500K/80CRI)
Lumen Adjustment Factor = 0.801 (2700K/90CRI desired)

Adjusted Lumen Output = Nominal Lumen Output x Lumen Adjustment Factor
Adjusted Lumen Output = 1025 lms/ft x 0.801 = 821 lms/ft

Example 2 - Custom Lumen Output based on Required Lumens Per Foot
Total light output (4ft) requirement of 2800 lms, desired CCT and CRI of 4000K/80CRI

Total required lumens per foot @ 4000K= 2800 lms / 4 ft = 700 lms/ft
Lumen Adjustment Factor = 1.018 (Requirement based on 4000K / 80CRI)

Total required lumens per foot @ 3500K / 80CRI = 700 lms/ft ÷ 1.018 = 688 lms/ft

Estimated efficacy = 121 LPW (find nearest value using table above)
Estimated power consumption = 688 lms/ft ÷ 121 lm/W = 5.69 W/ft

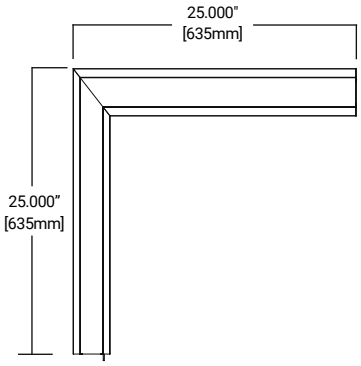
Custom Lumen Output

Total Light Output Range (lms/ft)

CCT	Lumen Adj Factors		Direct Output Range	
	80CRI	90CRI	80CRI	90CRI
2700K	N/A	0.792	N/A	230-796
3000K	0.943	0.815	273-948	236-819
3500K	1.000	0.861	290-1005	250-865
4000K	1.010	0.892	293-1015	259-896
5000K	1.010	0.892	293-1015	259-896

If your requirement is expressed in power consumption (W/ft) rather than light output, you can use the power to lumen output curves to convert power consumption to light output for specification. Efficacy for custom lumen outputs can be estimated using lumen output curves or with the use of our online custom lumen output tool.

Corner Transitions



Integrated Sensor Details and Placement

Sensor Type	Wireless	Sensor Integration	Sensor Mounting	Ordering Code
WaveLinx Pro	Yes	Integral to Fixture	Mounted in solid cover	WAA
WaveLinx Lite	Yes	Integral to Fixture	Mounted in solid cover	WAB
Enlighted	Yes	Integral to Fixture	Mounted in illuminated lens	LWIPD1
Stand-Alone SVPD1	No	Integral to Fixture	Mounted in solid cover	SVPD1

Optional standalone and wireless connected integrated sensors require use of the DD (0-10V) driver. WaveLinx and Enlighted sensors require additional system hardware (not provided) for full functionality.

Standard sensor layout is shown below. Please refer to sensor coverage pattern diagrams to ensure proper coverage for the application. Standard configurations are available in both individual fixtures and in continuous runs. Default spacing is based on the maximum fixture length of 12ft and can be changed to 8ft sensor spacing for additional coverage by selecting the 8ft max fixture length option when ordering.

For additional information integrated sensors and connected lighting, please visit Cooper Lighting Solutions's Connected Lighting Website.

○ Standard Sensor with Luminaire Control
⊗ Auxiliary Sensor used for Sensor Coverage (wireless systems only)

INTEGRAL SENSOR

≤8ft Individual ○

>8ft Individual ○ ⊗

Note: When 8ft max section length is used on individual fixtures > 8ft, sensor placement follows logic for continuous run.

Beginning of Run (BOR) ○

Intermediate Section (INT) ○

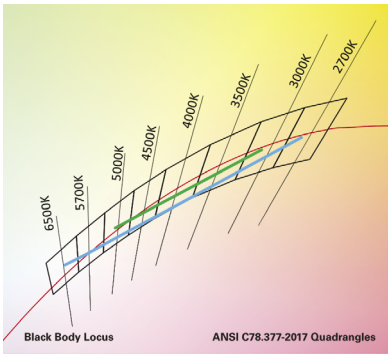
End of Run (EOR) > 4ft ○ ⊗

End of Run (EOR) ≤ 4ft ○

VividTune™
color tuning solutions

Define 2 Pendant LED with VividTune Tunable White

VividTune tunable white luminaires deliver high-quality light in a broad range of continuously variable color temperatures and intensities. Create a dynamic environment by adjusting the ambient light warmer or cooler to influence mood, support the task at hand, or create a dramatic ambience. The ability to control correlated color temperature and intensity separately using simple controls is the next evolution of LED lighting for the commercial, educational, healthcare and hospitality space. The unparalleled flexibility and number of available lighting environments enable users to find the right light with tunable white.



Performance Data*

Tunable White - Lumen Adjustment Factors

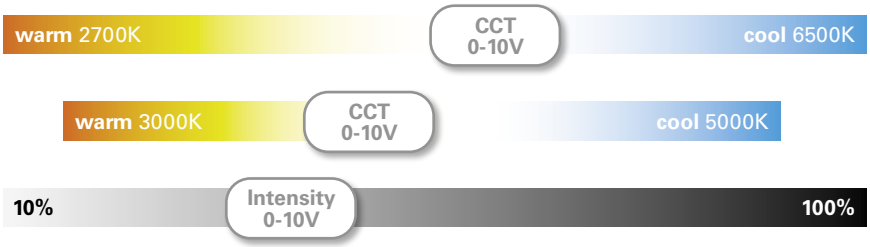
CCT	3000K-5000K		2700K-6500K	
	80 CRI	90 CRI	80 CRI	90 CRI
2700K	-	-	0.868	0.741
3000K	0.894	0.736	0.893	0.771
3500K	0.946	0.804	0.924	0.809
4000K	0.993	0.868	0.944	0.835
4500K	1.002	0.883	0.961	0.857
5000K	1.002	0.883	0.974	0.874
6500K	-	-	0.988	0.897

Example of Approximate Lumen Calculation

CCT Setting	Standard Catalog #	VividTune 80 CRI Catalog #	VividTune 90 CRI Catalog #
	S122DP-C865D835-X-UDD-F-W	S122DP-V865D83050-X-UW2A-F-W	S122DP-V865D93050-X-UW2A-F-W
3000K	-	3093	2547
3500K	3460	3273	2782
4000K	-	3436	3003
4500K	-	3467	3055
5000K	-	3467	3055

Controlling VividTune Tunable White

VividTune luminaires make tunable white more accessible by using simple and familiar controls. From wall dimmers to wireless controls, VividTune tunable white luminaires are compatible with industry standard 0-10V dimming controls. A single 0-10V dimming input is used to control intensity (brightness) while a second 0-10V dimming input is used to adjust CCT. For suggested control configurations, go to www.cooperlightingsolutions.com for tunable white application guides.



Example of Lumen Adjustment Calculation

S122DP-V865D83050-X-UW2A-F-W
at 80 CRI tuned to 3500K

Adjusted Lumen =
published lm x adjusted lm factor

Adjusted Lumen = 3460 x 0.946

Adjusted Lumen = 3273 lm

** Lumen adjustment factors are for reference and may be different for each product selected. Refer to IES files for actual performance data on each.*

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Aurora, CO 80011
P: 303-393-1522
www.cooperlighting.com

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Specifications and dimensions subject to change without notice.

KONCEPT

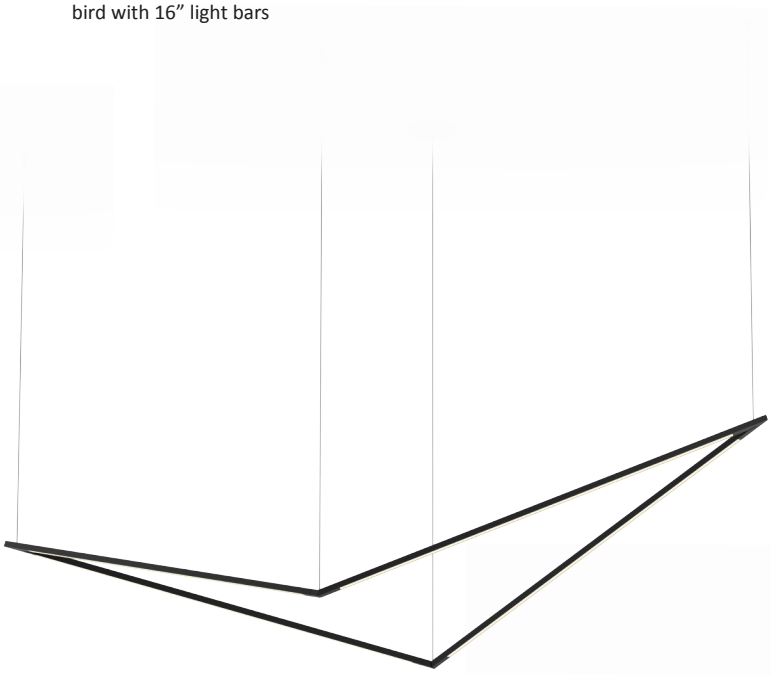
Z-Bar pendant *bird*

The renowned Z-Bar pendant bird is a unique, three-dimensional shape that invokes flight. Available in three standard finishes and four standard sizes, it brings an element of modernity to any interior.

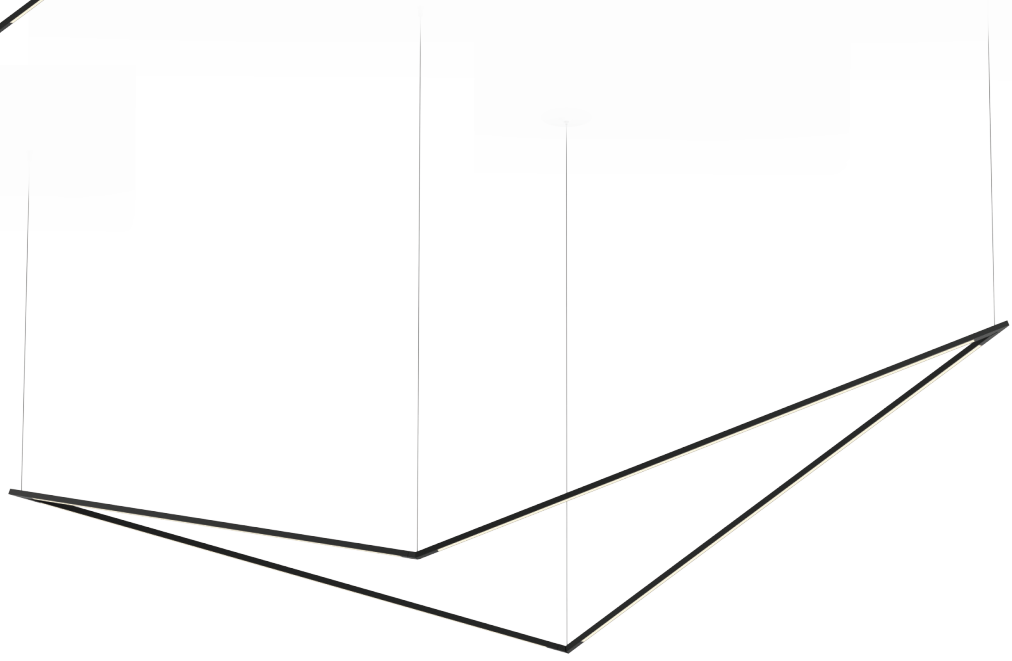
Standard Configurations

bird with 16” light bars

bird with 24” light bars



bird with 36” light bars



bird with 48” light bars

Z-Bar pendant bird at Midway Airport, Chicago

Standard Configurations

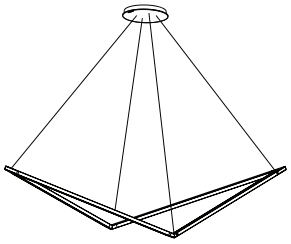
Lumens:	16-B: 1600 / 24-B: 2400 / 36-B: 2700 / 48-B: 5200
Energy Consumption:	16-B: 28 W / 24-B: 40 W / 36-B: 45 W / 48-B: 80 W
Rated Lifespan	>60,000 hours
Color Rendering Index (CRI) :	90
Brightness Adjustability:	Compatible with ELV wall dimmers*, 1-10V control
Material:	Aluminum, plastic
Cable length:	10’
Safety Rating:	C-UL-US Certified, CE
Warranty:	5 years; 1 year for hardwire driver
Voltage:	120V (canopy), 277V** (canopy) 100 - 240V, 277V (remote transformer)
Standard Finishes:	Matte black, matte white, silver
IES:	Visit koncept.com/zbarpendant for IES files

*Visit koncept.com/dimmers for information on compatible dimmers.
Remote transformers are only compatible with 1-10V dimmers.

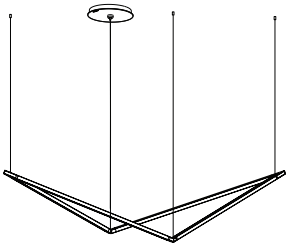
Power placement

There are two ways to mount the Z-Bar pendant bird using the canopy: monopoint installation or multipoint installation. The same parts are used for each installation method.

Monopoint installation



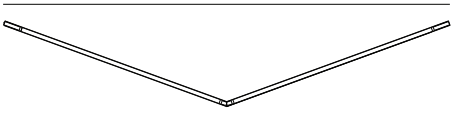
Multipoint installation



Dimensions

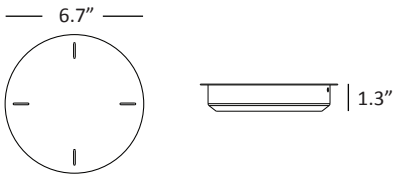
16-B = 10.5”
24-B = 14.68”
36-B = 22”
48-B = 29.36”

16-B = 34”
24-B = 49”
36-B = 70.5”
48-B = 92”



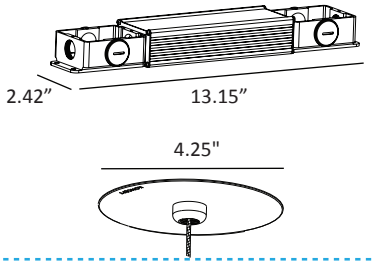
16-B = 6.75”
24-B = 9.375”
36-B = 13.375”
48-B = 17.375”

Canopy



*Compatible with 16-B, 24-B, 36-B only

Remote Transformer



How to specify

1. Choose an option from each column and enter into the appropriate fields at the bottom.
2. Submit this “SKU” to sales@koncept.com, along with any questions.

	Light Bar Length (in) (this is length of each light bar, NOT length of fixture.)	Model	Light Temperature (K)	Finish	Mount
ZBP	16 24 36 48	B	2,700* 3,000 (SW) 3,500* 4,000* 4,500* 5,000*	Silver (SIL) Matte Black (MTB) Matte White (MWT) Gold (GLD)	Canopy (CNP)** Remote Transformer (RTM)**

Order example: ZBP - 24 - B - SW - SIL - CNP

*Custom
**Remote Transformer is recommended for any configuration requiring more than 40 W energy consumption
Additional lead time/charges may be applied to non-stocked options

LEED information

Integrative Process

To support high-performance, cost-effective project outcomes through an early analysis of the interrelationships among systems.

Koncept’s LED lighting fixtures operate at high efficacy, therefore helping to minimize energy costs. All Koncept lighting fixtures are dimmable so that occupants can choose the appropriate setting to avoid energy overuse.

Interior Lighting

To promote occupants’ productivity, comfort and well-being by providing high-quality lighting.

Koncept’s entire line of hardwired lighting fixtures are dimmable. Users can adjust the brightness settings to suit their needs. Furthermore, all products utilize high quality LED light sources with CRI over 80 and L90 rated lifespan over 60,000 hours.

GSA

On GSA schedule

TYPE H

Project		Catalog #		Type	
Prepared by		Notes		Date	

Lumark

Prevail Petite Discrete Wall

Wall Mount Luminaire

Product Features

BAA

Interactive Menu

- Ordering Information page 2
- Mounting Details page 3
- Product Specifications page 3
- Energy and Performance Data page 4
- Control Options page 5

Product Certifications

TSN CERTIFIED, UL CERTIFIED, DLC LISTED [1], DLC LISTED PREMIUM [1], FC CLASS A CAN ICES-005, RoHS COMPLIANT, IP66, ida DARK SKY APPROVED [2], 5 YEAR LIMITED WARRANTY

Quick Facts

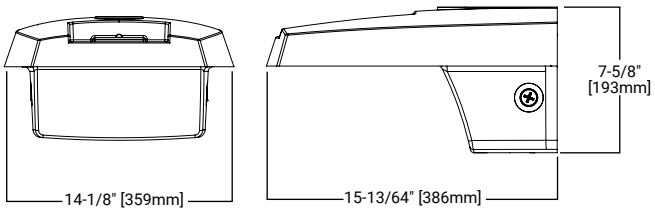
- Direct-mounted discrete light engine for improved optical uniformity and visual comfort
- Lumen packages range from 4,300 - 11,300 lumens (30W - 90W)
- Replaces 70W up to 250W HID equivalents
- Efficacies up to 147 lumens per watt
- Surface mount configuration with standard conduit entry

Connected Systems

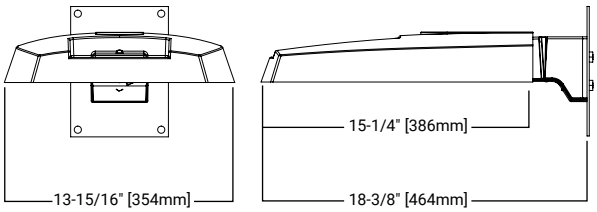
- WaveLinx

Dimensional Details

Surface Mount (SM)



Wall Mount (WM)



NOTES:
1. Visit https://www.designlights.org/search/ to confirm qualification. Not all product variations are DLC qualified.
2. IDA Certified for 3000K CCT and warmer only.

Ordering Information

SAMPLE NUMBER: **PRV-P-PA1B-740-U-T4W-SM-BZ**

Product Family [1]	Light Engine		Color Temperature	Voltage	Distribution	Mounting (Included)	Finish
	Configuration	Drive Current [2]					
PRV-P=Prevail Petite **BAA-PRV-P**=Prevail Petite BAA Compliant [23] **TAA-PRV-P**=Prevail Petite TAA Compliant [23]	**PA1**=1 Panel, 24 LED Rectangle	**A**=400mA Nominal **B**=700mA Nominal **C**=950mA Nominal **D**=1200mA Nominal	**740**=70CRI, 4000K **730**=70CRI, 3000K **750**=70CRI, 5000K	**U**= Universal, 120-277V **H**= High Voltage, 347-480V **1**=120V **2**=208V **3**=240V **4**=277V **8**=480V [3, 24] **9**=347V **DV**=Duravolt, 277-480V	**T2R**=Type II Roadway **T2U**=Type II Urban **T3**=Type III **T4W**=Type IV Wide **5WQ**=Type V Square Wide	**SM**=Surface Wall Mount **WM**=Wall Mount Arm	**BZ**=Bronze **AP**=Grey **BK**=Black **DP**=Dark Platinum **GM**=Graphite Metallic **WH**=White

Options (Add as Suffix)

10K=10kV UL 1449 Fused Surge Protective Device
20MSP=20kV MOV Surge Protective Device
20K=20kV UL 1449 Fused Surge Protective Device
2L=Two-Circuit Light Engine [20]
F=Single Fuse (Used with Voltages 120, 277 or 347V)
FF=Double Fuse (Used with Voltages 208, 240 or 480V)
EBP=Emergency Battery Pack (Ambient Temp, 0° to 40°C) [4, 5]
CBP=Cold Weather Emergency Battery Pack (Ambient Temp, -20° to 40°C) [4, 5]
CBP-CEC=Cold Weather Emergency Battery Pack, CEC Compliant (Ambient Temp, -20° to 40°C) [4, 5]
HSS=House Side Shield (Factory Installed) [6]
HA=50°C High Ambient Temperature [7]
CC=Coastal Construction [8]
BPC=Button Photocontrol [9]
PR=NEMA 3-PIN Twistlock Photocontrol Receptacle [9, 10]
PR7=NEMA 7-PIN Twistlock Photocontrol Receptacle [9, 10]
MS/DIM-L08=Dimming Motion and Daylight Sensor, IR Remote Programmable, < 8' Mounting [9, 11, 12]
MS/DIM-L20=Dimming Motion and Daylight Sensor, IR Remote Programmable, 8' - 20' Mounting [9, 11, 12]
MS/DIM-L40=Dimming Motion and Daylight Sensor, IR Remote Programmable, 21' - 40' Mounting [9, 11, 12]
SPB1=Dimming Motion and Daylight Sensor, Bluetooth Programmable, < 8' Mounting [9, 11, 13]
SPB2=Dimming Motion and Daylight Sensor, Bluetooth Programmable, 8' - 20' Mounting [9, 11, 13]
SPB4=Dimming Motion and Daylight Sensor, Bluetooth Programmable, 21' - 40' Mounting [9, 11, 13]
ZW=Wavelinx-enabled 4-PIN Twistlock Receptacle [9, 11, 14, 15]
ZD=SR Driver-enabled 4-PIN Twistlock Receptacle [9, 11, 14, 15]
ZW-SWPD4XX=WaveLinx Pro, Dimming Motion and Daylight, WAC Programmable, 7' - 15' Mounting [9, 11, 14, 15, 16]
ZW-SWPD5XX=WaveLinx Pro, Dimming Motion and Daylight, WAC Programmable, 15' - 40' Mounting [9, 11, 14, 15, 16]
ZD-SWPD4XX=WaveLinx Pro, SR Driver, Dimming Motion and Daylight, WAC Programmable, 7' - 15' Mounting [9, 11, 14, 15, 16]
ZD-SWPD5XX=WaveLinx Pro, SR Driver, Dimming Motion and Daylight, WAC Programmable, 15' - 40' Mounting [9, 11, 14, 15, 16]

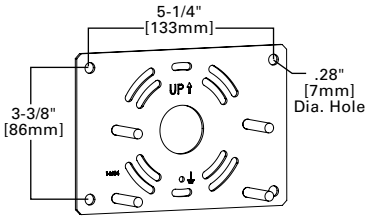
Accessories (Order Separately) [18, 19]

HSS-HP=House Side Shield, Horizontal Panel [7]
OA/RA1013=Photocontrol Shorting Cap
OA/RA1014=NEMA Photocontrol - 120V
OA/RA1016=NEMA Photocontrol - Multi-Tap 105-285V
OA/RA1201=NEMA Photocontrol - 347V
OA/RA1027=NEMA Photocontrol - 480V
FSIR-100=Wireless Configuration Tool for Occupancy Sensor [21]
WOLC-7P-10A=WaveLinx Outdoor Control Module (7-PIN) [22]
SWPD4-XX=WaveLinx Wireless Sensor, 7' - 15' Mounting Height [15, 16, 17]
SWPD5-XX=WaveLinx Wireless Sensor, 15' - 40' Mounting Height [15, 16, 17]

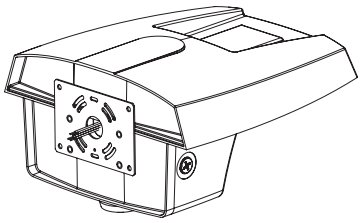
NOTES:
1. DesignLights Consortium® Qualified. Refer to www.designlights.org Qualified Products List under Family Models for details.
2. Nominal drive currents shown here. For actual drive current by configuration, refer to Power and Lumens tables.
3. 480V not to be used with ungrounded or impedance grounded systems.
4. Only available on Surface Wall Mount (SM) mounting.
5. Must use with Univeral (U) voltage only. Not available with other voltage options. Not available with PA1D light engine.
6. House Side Shield not for use with 5WQ distribution.
7. Not available with EBP, CBP, or CBP-CEC options. Not available with PA1D light engine.
8. Salt spray tested to over 5,000-hours per ASTM B117 with a scribe rating of 9 per ASTM D1654. Also achieves 7,000-hour rating per ASTM B117 with a scribe rating of 4 per ASTM D1654. Extended lead times may apply.
9. Option is not available with other controls: photocontrols (BPC), photocontrol receptacles (PR or PR7), or controls systems (MS, ZD, or ZW).
10. If High Voltage (H) or DuraVolt (DV) is specified, use a photocontrol that matches the input voltage used.
11. Option not available with High Voltage (H). Must specify Universal (U), 347V (9), or 480V (8) voltage.
12. Utilizes the Wattstopper sensor FSP-211. Sensor color white unless specified otherwise via PDR. To field-configure, order FSIR-100 accessory separately.
13. Utilizes the Wattstopper sensor FSP-3XX series. Sensor color determined by product finish. See Sensor Color Reference Table. Field-configures via mobile application. See Controls section for details.
14. Sensor passive infrared (PIR) may be overly sensitive when operating below -20°C (-4°F).
15. In order for the device to be field-configurable, requires WAC Gateway components WAC-PoE and WPOE-120 in appropriate quantities. Only compatible with WaveLinx system and software and requires system components to be installed for operation. See website for more Wavelinx application information.
16. Replace XX with sensor color (WH, BZ or BK).
17. Requires 4-PIN twistlock receptacle option (ZD or ZW) option.
18. For BAA or TAA requirements, Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information.
19. Replace XX with paint color.
20. Controls and/or emergency battery packs operate only one of the two circuits when 2L is specified.
21. This tool enables adjustment to Motion Sensor (MS) parameters including high and low modes, sensitivity, time delay, cutoff and more. Consult your lighting representative for more information.
22. Requires 7-PIN NEMA twistlock photocontrol receptacle (PR7) option. The WOLC-7 cannot be used in conjunction with other controls systems (MS, ZD, or ZW). Only for use at 120-347V.
23. Only product configurations with these designated prefixes are built to be compliant with the Buy American Act of 1933 (BAA) or Trade Agreements Act of 1979 (TAA), respectively. Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.
24. DuraVolt drivers feature added protection from power quality issues such as loss of neutral, transients and voltage fluctuations. Visit www.signify.com/duravolt for more information.

Mounting Details

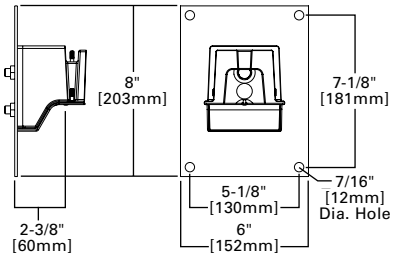
Surface Mount Plate (SM)



Surface Mount Assembly (SM)



Wall Mount (WM)



Product Specifications

Construction

- Single-piece die-cast aluminum housing
- Tethered die-cast aluminum door
- Surface Mount (SM) offers two 1/2" NPT conduit entry plugs
- Not suitable for inverted mount installation

Optics

- Dark Sky Approved (3000K CCT and warmer only)
- Precision molded polycarbonate optics

Electrical

- -40°C minimum operating temperature
- 40°C maximum operating temperature
- >.9 power factor
- <20% total harmonic distortion
- Class 1 electronic drivers have expected life of 100,000 hours with <1% failure rate
- 0-10V dimming driver is standard with leads external to the fixture
- Standard MOV surge protective device designed to withstand 10kV of transient line surge

Typical Applications

- Outdoor, Pedestrian Pathways, Building Entrances, Loading Docks, Perimeter Parking Lots

Finish

- Five-stage super TGIC polyester powder coat paint, 2.5 mil nominal thickness

Shipping Data

- Prevail Petite (with CBP): 21 lbs. (9.53 kgs.)

Warranty

- Five year limited warranty, consult website for details. www.cooperlighting.com/legal

Energy and Performance Data

Power and Lumens

Light Engine		PA1A	PA1B	PA1C	PA1D
Power (Watts)		31	53	72	93
Drive Current (mA)		375	670	930	1200
Input Current @ 120V (A)		0.26	0.44	0.60	0.78
Input Current @ 277V (A)		0.12	0.20	0.28	0.35
Input Current @ 347V (A)		0.10	0.17	0.23	0.29
Input Current @ 480V (A)		0.07	0.13	0.17	0.22
Distribution					
Type II Roadway	4000K/5000K Lumens	4,505	7,362	9,495	11,300
	BUG Rating	B1-U0-G1	B1-U0-G2	B1-U0-G2	B1-U0-G2
	Lumens per Watt	147	139	132	121
	3000K Lumens [1]	4,103	6,705	8,647	10,291
Type II Roadway w/ HSS	4000K/5000K Lumens	3,727	6,091	7,855	9,349
	BUG Rating	B0-U0-G1	B0-U0-G2	B0-U0-G2	B1-U0-G2
	Lumens per Watt	121	115	109	100
	3000K Lumens [1]	3,394	5,547	7,154	8,514
Type II Urban	4000K/5000K Lumens	4,496	7,347	9,476	11,277
	BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G2	B3-U0-G3
	Lumens per Watt	146	139	131	121
	3000K Lumens [1]	4,095	6,691	8,630	10,271
Type II Urban w/ HSS	4000K/5000K Lumens	3,253	5,316	6,856	8,160
	BUG Rating	B1-U0-G1	B1-U0-G1	B1-U0-G2	B1-U0-G2
	Lumens per Watt	106	101	95	87
	3000K Lumens [1]	2,963	4,841	6,244	7,431
Type III	4000K/5000K Lumens	4,443	7,261	9,364	11,145
	BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	B2-U0-G2
	Lumens per Watt	145	138	130	119
	3000K Lumens [1]	4,046	6,612	8,528	10,150
Type III w/ HSS	4000K/5000K Lumens	3,406	5,566	7,179	8,543
	BUG Rating	B0-U0-G1	B1-U0-G2	B1-U0-G2	B1-U0-G2
	Lumens per Watt	111	105	100	91
	3000K Lumens [1]	3,102	5,069	6,538	7,781
Type IV Wide	4000K/5000K Lumens	4,348	7,106	9,164	10,906
	BUG Rating	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G3
	Lumens per Watt	142	135	127	117
	3000K Lumens [1]	3,960	6,471	8,346	9,932
Type IV Wide w/ HSS	4000K/5000K Lumens	3,318	5,422	6,993	8,323
	BUG Rating	B0-U0-G1	B1-U0-G2	B1-U0-G2	B1-U0-G2
	Lumens per Watt	108	103	97	89
	3000K Lumens [1]	3,022	4,938	6,369	7,580
Type V Square Wide	4000K/5000K Lumens	4,497	7,349	9,478	11,280
	BUG Rating	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2
	Lumens per Watt	146	139	131	121
	3000K Lumens [1]	4,095	6,693	8,632	10,273

NOTES:
1. For 3000K or HSS BUG Ratings, refer to published IES files.

Power and Lumens: Emergency Configurations

Light Engine		PA1A	PA1B	PA1C
Power (Watts) [1]		37	59	78
Input Current @ 120V (A)		0.33	0.52	0.68
Input Current @ 277V (A)		0.16	0.24	0.31
Distribution [2]				
Type II Roadway	4000K/5000K Lumens	2,035		
	3000K Lumens	1,853		
Type II Urban	4000K/5000K Lumens	2,030		
	3000K Lumens	1,849		
Type III	4000K/5000K Lumens	2,007		
	3000K Lumens	1,827		
Type IV Wide	4000K/5000K Lumens	1,964		
	3000K Lumens	1,788		
Type V Square Wide	4000K/5000K Lumens	2,031		
	3000K Lumens	1,849		

NOTES:
1. Power and current based on full power consumption while EBP or CBP is charging.
2. Estimated lumen outputs while luminaire is operating in emergency mode only at full charge.

Lumen Maintenance

Configuration	TM-21 Lumen Maintenance (50,000 Hours)	Theoretical L70 (Hours)
Up to 50°C	96.76%	> 663,000

Sensor Color Reference Table (SPBx)

Housing Finish	Sensor Color
AP=Grey	Grey
BZ=Bronze	Bronze
BK=Black	Black
DP=Dark Platinum	Grey
GM=Graphite Metallic	Black
WH=White	White

Lumen Multiplier

Ambient Temperature	Lumen Multiplier
0°C	1.02
10°C	1.01
25°C	1.00
40°C	0.99
50°C	0.97

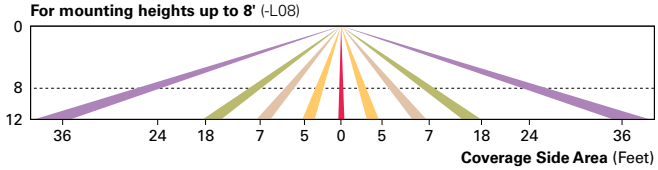
Control Options

0-10V This fixture provides 0-10V dimming wire leads for use with a lighting control panel or other control method.

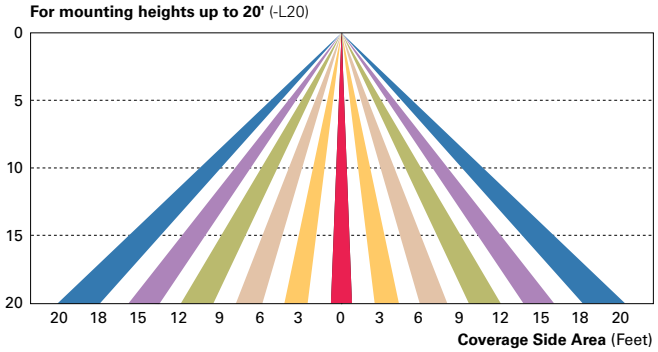
Photocontrol (PR and PR7) Photocontrol receptacles provide a flexible solution to enable "dusk-to-dawn" lighting by sensing light levels. Advanced control systems compatible with NEMA 7-PIN standards can be utilized with the PR7 receptacle.

Dimming Occupancy Sensor (SPB, MS/DIM-LXX and MS-LXX) These sensors are factory installed in the luminaire housing. When the SPB or MS/DIM sensor options are selected, the luminaire will dim down after five minutes of no activity detected. When activity is detected, the luminaire returns to full light output. When a sensor for ON/OFF operation (MS-LXX) is selected, the luminaire will turn off after five minutes of no activity. These occupancy sensors include an integral photocell for "dusk-to-dawn" control or "daylight harvesting." Factory default is enabled for the MS sensors and disabled for the SPB. SPB motion sensors require the Sensor Configuration mobile application by Wattstopper to change factory default dimming level, time delay, sensitivity and other parameters. Available for iOS and Android devices. The SPB sensor is factory preset to dim down to approximately 10% power with a time delay of five minutes.

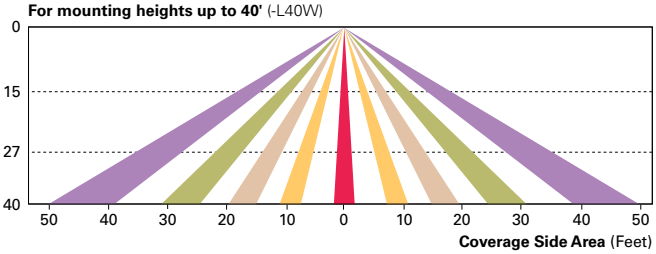
For mounting heights up to 8' (-L08)



For mounting heights up to 20' (-L20)



For mounting heights up to 40' (-L40W)

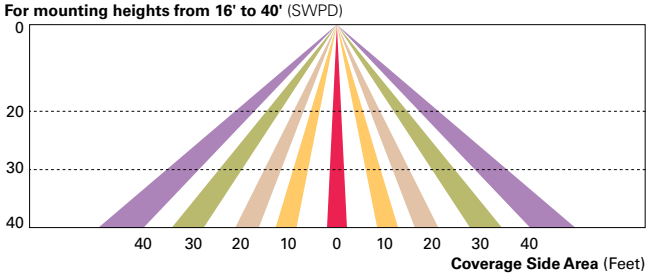


WaveLinx Wireless Control and Monitoring System Available in 7-PIN or 4-PIN configurations, the WaveLinx Outdoor control platform operates on a wireless mesh network based on IEEE 802.15.4 standards enabling wireless control of outdoor lighting. At least one Wireless Area Controller (WAC) is required for full functionality and remote communication (including adjustment of any factory pre-sets).

WaveLinx Outdoor Control Module (WOLC-7P-10A) A photocontrol that enables astronomic or time-based schedules to provide ON, OFF and dimming control of fixtures utilizing a 7-PIN receptacle. The out-of-box functionality is ON at dusk and OFF at dawn.

WaveLinx Wireless Sensor (SWPD4 and SWPD5) These outdoor sensors offer passive infrared (PIR) occupancy sensing and a photocell for closed-loop daylight sensing. These sensors can be factory installed or field-installed via simple, tool-less integration into luminaires equipped with the Zhaga Book 18 compliant 4-PIN receptacle (ZD or ZW). These sensors are factory preset to dim down to approximately 50 percent power after 15 minutes of no activity detected, and the photocell for "dusk-to-dawn" control is default enabled. A variety of sensor lenses are available to optimize the coverage pattern for mounting heights from 7'-40'.

For mounting heights from 16' to 40' (SWPD)



Cooper Lighting Solutions
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

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Specifications and dimensions
subject to change without notice.

TYPE J

Project		**Catalog #**		**Type**	
Prepared by		**Notes**		**Date**	

Portfolio

LER4C/LESQ4C Cylinders

4" Round and Square Cylinder
Surface, Ceiling, Wall, Up/Down, Yoke, and Stem Mount

Typical Applications
Office • Education • Healthcare • Hospitality • Retail • Residential

Interactive Menu

- Order Information page 2
- Product Specifications page 4
- Energy Data page 5
- Photometric Data page 6
- Connected Systems page 14
- Product Warranty

Product Certification

ENERGY STAR · Efficiency Standards T24 · RoHS COMPLIANT · UL CERTIFIED

Control Compatibility

WaveLinx LITE · WaveLinx PRO

Product Features

powered by fifthlight technology · TAA COMPLIANT OPTIONS AVAILABLE · damp location · wet location

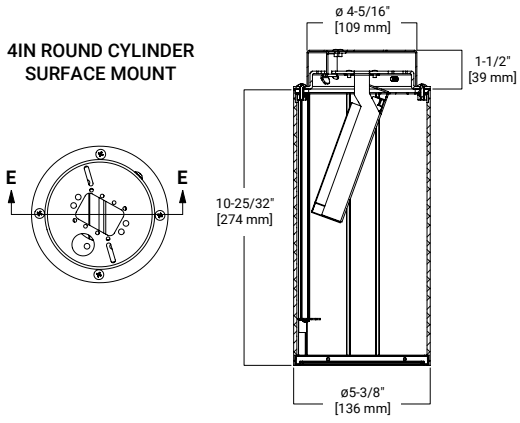
Top Product Features

- 250 to 4,000 lumens; Offered in 90 and 97 CRI; Downlight
- Extruded aluminum housing; Matte Black, White, Bronze and Silver paint finishes
- 6 color temperatures: 2400K, 2700K, 3000K, 3500K, 4000K and 5000K CCT
- Options to meet Trade Agreements Act requirements

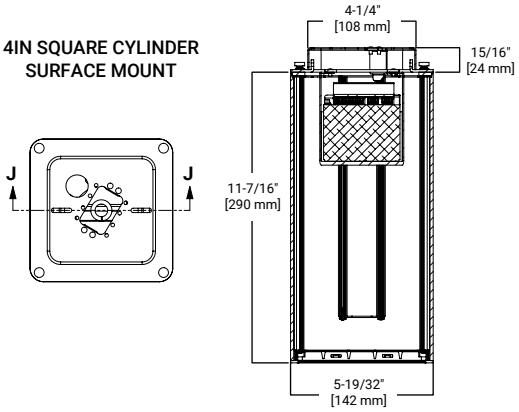
Dimensional and Mounting Details

additional product diagrams

4IN ROUND CYLINDER SURFACE MOUNT



4IN SQUARE CYLINDER SURFACE MOUNT



Order Information

SAMPLE ORDER NUMBER: **LER4C10D010TRP**

Domestic Preferences [30]	Cylinder	Lumens	Driver	Remote [8]	Finish [10]	Factory Installed Connected Lighting Options
[Blank]=Standard **TAA**= Trade Agreements Act	**Ceiling surface mount** **LER4C**=4-inch round surface mount **LESQ4C**= 4-inch square surface mount square aperture [1] **LESQR4C**= 4-inch square surface mount round aperture [2] **Ceiling surface mount Square with conduit canpoy (for round use Conduit Canopy Kit accessory)** **LESQSM4C** = 4-inch square surface mount square aperture with surface mount conduit canopy [1] **LESQRSM4C** = 4-inch square surface mount, round aperture with surface mount conduit canopy [2] **Wall mount Downlight** **LERWM4C**= 4-inch round wall mount **LESQRWM4C**= 4-inch square wall mount round aperture [2] **LESQWM4C**= 4-inch square wall mount square aperture [1] **Wall mount Up/down** **LERUD4C**= 4-inch round wall mount up/down [4] [36] **LESQUD4C**= 4-inch square wall mount up/down square aperture [3] [36] **LESQRUD4C**= 4-inch square wall mount up/down round aperture [4] [36] **Yoke mount** **LERYM4C** = 4-inch round yoke mount [24] **LESQYM4C** = 4-inch square yoke mount square aperture [1] [24] **LESQRYM4C** = 4-inch square yoke mount round aperture [2] [24]	**02**=250 lumens **05**=500 lumens **08**=800 lumens **10**=1000 lumens **15**=1500 lumens **20**=2000 lumens **25**=2500 lumens **30**=3000 lumens **35**=3500 lumens **40**=4000 lumens	**D010**=0-10V Dimming, 1% to 100%, 120V-277V **3D010**=0-10V Dimming, 1% to 100%, 347V, 800-3500 Lumens (250, 500, 4000 Lumens requires a Remote Driver) **D010TR**=0-10V (120-277V) or line voltage (120V) dimming, 5-100%; 1 driver: 250 to 3500 / 2 drivers: (Downlight and Remote only): 4000 Lumens **DE010**=0-10V Linear Dimming, 0% to 100%, 120V-277V, 500-4000 lumens **D5LT**=Fifth Light® DALI DT6 Logarithmic Dimming, 0% to 100%, 120V-277V, 500-4000 lumens **DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, 800-4000 lumens [6] **DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, with RJ45 connection, 800-4000 lumens [6] **DL2**=1 to 100% dimming, 120V Lutron Hi-Lume forward phase dimming; 1 driver: 800 to 3500 Lumens / 2 drivers: (Downlight and Remote only): 4000 Lumens **DLE**=Lutron Ecosystem dimming 1% to 100%, 120-277V; 1 driver: 800 to 3500 Lumens / 2 drivers: (Downlight and Remote only): 4000 Lumens **DLV**=Low Voltage System, 800-3000 lumens	**blank**=Integral driver **R**=Remote driver [9]	**P**=White **MB**=Matte Black **SL**=Silver **BZ**=Bronze	**WPN** = WaveLinx PRO Wireless Node without sensor [14]

Power Module **Choose between EC4C downlight or ECA4C adjustable**

SAMPLE ORDER NUMBER: **EC4C10209035**

Domestic Preferences [30]	Power Module	Lumen Levels [15]	Color	
[Blank]=Standard **TAA**= Trade Agreements Act	**EC4C**=4-inch cylinder light engine	**0208**=250, 500, 800 Lumens **1020**=1000, 1500, or 2000 Lumens **2535**=2500, 3000, 3500 Lumens **4000**=4000 Lumens **Two LEDs for cylinders with two drivers** **4075**=4000 lumens (For use with Lutron and D010TR)	**90 CRI** **9024**= 90CRI, 2400K **9027**= 90CRI, 2700K **9030**= 90CRI, 3000K **9035**= 90CRI, 3500K **9040**= 90CRI, 4000K **9050**= 90CRI, 5000K	**97 CRI** **9727**= 97CRI, 2700K **9730**= 97CRI, 3000K

SAMPLE ORDER NUMBER: **ECA4C1020FL9030MW**

Domestic Preferences [30]	Power Module [15]	Distribution	Color		Finish
[Blank]=Standard **TAA**= Trade Agreements Act	**ECA4C0208** =4-inch cylinder adjustable light engine; 250, 500, 800 Lumens **ECA4C1020** =4-inch cylinder adjustable light engine; 1000, 1500, or 2000 Lumens	**NFL**=Narrow Flood **FL**=Flood	**90 CRI** **9024**= 90CRI, 2400K **9027**= 90CRI, 2700K **9030**= 90CRI, 3000K **9035**= 90CRI, 3500K **9040**= 90CRI, 4000K **9050**= 90CRI, 5000K	**97 CRI** **9727**= 97CRI, 2700K **9730**= 97CRI, 3000K	**MW**=Matte White **MB**=Matte Black **MMS**=Matte Metallic Silver

Trim is included with ECA4C adjustable power module. Do not order a separate trim.

SAMPLE ORDER NUMBER: **4LBN3LI**

Domestic Preferences [30]	Trim	Distribution[16]		Flange	Finish	
[Blank]=Standard **BAA**=Buy American Act [35]	**4LB**=4" LED	**N**=Narrow (30° Beam), Spun Aluminum **M**=Medium (50° Beam), Spun Aluminum **MD**=45°Cutoff, Medium Beam, Spun Aluminum **W**=Wide (75° Beam), Spun Aluminum **S**=Shallow (75° Beam), Spun Aluminum **HY**=Hyperbolic Medium Beam (Single LED drivers only) **CS**=Cast Shallow (75° Beam), Die Cast Aluminum **BA**=Spun Aluminum Baffle	**SWN**=Single Wall Wash, Spun Aluminum **DWN**=Double Wall Wash, Spun Aluminum **LSWW**=Lensed Single Wall Wash, Spun Aluminum **LDWW**=Lensed Double Wall Wash, Spun Aluminum **Square** **SQ**=Anodized Aluminum **CSSQ**=Shallow Die Cast Aluminum	**3**=Rimless	**LI**=Specular Clear[17] **H**=Semi-Specular Clear[17] **WMH**=Warm Haze[17] **WH**=Wheat[17] **GPH**=Graphite Haze[17]	**B**=Specular Black[17] **MW**=Matte White **MB**=Matte Black[18] **MMS**=Matte Metallic Silver[19]

continued on next page

Order Information

REQUIRED if Remote Driver (R) is specified on Cylinder

Domestic Preferences (30)	Remote Drivers(8)	Lumens	Voltage	Driver	Options (31) (33)	Controls
[Blank]=Standard **TAA**= Trade Agreements Act	**RC100**=Remote 100 ft **RC75**= Remote 75 ft **RC50**= Remote 50 ft **RC25**= Remote 25 ft **RC15**= Remote 15 ft **RC5**= Remote 5 ft **RC2**= Remote 2 ft	**02**=250 lumens **05**=500 lumens **08**=800 lumens **10**=1000 lumens **15**=1500 lumens **20**=2000 lumens **25**=2500 lumens **30**=3000 lumens **35**=3500 lumens **40C**=4000 lumens	**blank**=120-277V (250-3500 lumens) (11) **1**=120V (3500 & 4000 lumens only) **2**=277V (3500 & 4000 lumens only) **3**=347V (34)	**D010**=0-10V Dimming, 1% to 100%, 120V-277V **D010TR**=0-10V (120-277V) or line voltage (120V) dimming, 5-100%; 1 driver: 250 to 3500 / 2 drivers: (Downlight only): 4000 Lumens **DE010**=0-10V Linear Dimming, 0% to 100%, 120V-277V, 500-4000 lumens **D5LT**=Fifth Light® DALI DT6 Logarithmic Dimming, 0% to 100%, 120V-277V, 500-4000 lumens **DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, 800-4000 lumens (6) **DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, with RJ45 connection, 800-4000 lumens (6) **DL2**=1 to 100% dimming, 120V Lutron Hi-Lume forward phase dimming; 1 driver: 800 to 3500 Lumens / 2 drivers: (Downlight only): 4000 Lumens (12) **DLE**=Lutron Ecosystem dimming 1% to 100%, 120-277V; 1 driver: 800 to 3500 Lumens / 2 drivers: (Downlight only): 4000 Lumens (12) **DLV**=Low Voltage System, 800-3000 lumens	**EMBOD**=Bodine® Emergency Module with Remote Test Switch **EMBOD6ST**=Bodine® 6W Self Test Emergency Module with Remote Test Switch **EM7**=7W Emergency Module with Remote Test Switch **EM14**=14W Emergency Module with Remote Test Switch **EMBOD7ST**=Bodine® Self Test Emergency Module **EMV7**=7W Low Voltage Emergency Module with Remote Test Switch (21) **EMV14**=14W Low Voltage Emergency Module with Remote Test Switch (21) **ETRD**=Emergency transfer device (32)	**WPST**=Factory installed Wavelinx (includes control module, sensor, cable, tile mount and ceiling mount sensor) (14) (28) **WLST**=Factory installed WaveLinx Lite Sensor Kit (14) (27) **WPN** = WaveLinx PRO Wireless Node without sensor (14)

Domestic Preferences (30)	Accessories	Type	Lengths
[Blank]=Standard **TAA**= Trade Agreements Act	**Pendant Kit**(20) **P436P**=White pendant stem kit for round suspended mount cylinder **P436BZ**=Bronze pendant stem kit for round suspended mount cylinder **P436MB**=Matte black pendant stem kit for round suspended mount cylinder **P436SL**=Silver pendant stem kit for round suspended mount cylinder	**Blank**=5 conductor for use with 0-10V driver **3C**=3 conductor for use with 120 or 277V **5C**= 5 conductor for use with D5LT drivers **DMX**=No conductors for use with DMX and remote drivers **RM** = for Remote drivers	**Blank**=36" **SP*=*** Specify 6" to 144" in 1" increments
	Conduit pendant kit(26) **PMRCC4P** = Round pendant stem kit with conduit knockout cover, white **PMRCC4MB** = Round pendant stem kit with conduit knockout cover, black **PMRCC4CZ** = Round pendant stem kit with conduit knockout cover, bronze **PMRCC4SL** = Round pendant stem kit with conduit knockout cover, silver **PMSQCC4P** = Square pendant stem kit with conduit knockout cover, white **PMSQCC4MB** = Square pendant stem kit with conduit knockout cover, black **PMSQCC4CZ** = Square pendant stem kit with conduit knockout cover, bronze **PMSQCC4SL** = Square pendant stem kit with conduit knockout cover, silver		**Blank**=36" **SP*=*** Specify 6" to 144" in 1" increments
	Aircraft cable (26) **AC4120P=**120" white aircraft cable kit **AC448P**=48" white aircraft cable kit **AC4120MB=**120" black aircraft cable kit **AC448MB**=48" black aircraft cable kit	**Blank**=5 conductor **DMXC5**=DMX/RDM logarithmic Dimming with RJ45 connection	
	LNE4RUD=up/down gasketed lens, wet location, round **LNS4SQUD** = up/down gasketed lens, wet location square **Conduit Kit** (26) **SMRCC4P** = Round conduit canopy for round surface mount, white **SMRCC4MB** = Round conduit canopy for round surface mount, black **SMRCC4CZ** = Round conduit canopy for round surface mount, bronze **SMRCC4SL** = Round conduit canopy for round surface mount, silver **Connected Lighting Systems**(14) **WTA** = Field installed WaveLinx sensor Kit (27) **WTK** = Field installed WaveLinx Lite Sensor Kit(28)		

Notes

(1) Square reflector
(2) Round reflector
(3) Square reflector, requires two reflectors and light engines
(4) Round reflector, requires two reflectors and light engines
(5) 347V integral D010 only. 800-3500 lumens for integral driver. 250, 500, 4000 lumens for remote driver.
(6) DMX fixtures default to full on upon loss of DMX signal
(8) Up down surface mount require 2 driver assemblies
(9) Order remote driver separately. See below to order.
(10) Consult factory for custom finishes.
(11) 3000 and below. Up to 3000 lumens does not need voltage specified.
(12) Only available up to 25 ft.
(13) Not available with up/down
(14) Refer to system specifications for additional information, features, and benefits. Order either factory installed option or accessory. Use with 0-10V driver. WPN factor installed only.
(15) Nominal Lumens will vary depending on selected color, driver and reflector finish.
(16) Beam angles are nominal with LI finish trims.
(17) Not available on CS or BA distributions
(18) Available with BA and CS distributions
(19) Available only on CS distributions
(20) 0-45° slope.
(21) ULus listed only
(24) Ceiling mount only
(26) Not for use with remote driver
(27) WLST = WaveLinx Lite tile mount sensor kit for daylight dimming, PIR motion sensing, use with D010 only (Refer to WaveLinx Lite system specifications)
(28) WPST = WaveLinx wireless sensor kit for daylight dimming, PIR motion sensing, and optional RLTS - Real Time Location Services, use with 0-10V only
(30) To order product that is compliant with the Buy American Act of 1933 (BAA) or Trade Agreements Act (TAA), use the online specification configurator to specify BAA or TAA. Please refer to DOMESTIC PREFERENCES LINK for more information. Components shipped separately may be separately analyzed under domestic preference requirements. Accessories sold separately will be separately analyzed under domestic preference requirements.
(31) 120V-277V
(32) Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others).
(33) Non-IC
(34) D010 800 to 4000 lumens. 250, 500 and 4000 lumens use step down transformer) All other drivers use step down transformer.
(35) Offered with spun aluminum narrow (N), medium (M) and wide (W) trims.
(36) DMX drivers with shallow trim only.

Product Specifications

Lower Reflector
- Painted die-cast aluminum or spun aluminum lower reflector with a lensed upper optical chamber provides superior lumen output with minimal source brightness
- Square surface mount available with square or round reflectors
- Spun reflectors are available in all Portfolio finishes
- Directional with baffle tilts from 0°-30°

Trim retention
- Two torsion springs hold flange tightly to the cylinder lip

Cylinder
- Round and soft square extruded aluminum
- Matte white, bronze, silver or matte black. Contact factory for custom finishes.
- Available in standard and shallow heights
- Yoke mount provides +/-45° lockable tilt

Mounting
- Mounting plate installs to mounted junction box
- Cylinder mounts to plate with easy twist and lock hooks for ceiling mount
- For wall mount, mounting arm attaches directly to junction box via a robust mounting plate
- Offered with optional stem and aircraft cable
- Conduit canopy allows for mounting pendant and surface cylinder on hard ceilings provided in painted finish to match the cylinder accommodates ½" or ¾" conduit.

Thermal
- Aluminum heat sink conducts heat away from the LED module for optical performance and longer life

LED System
- Contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution without pixilation
- Auto resetting, thermally protected, LED's are turned off when safe operating temperatures are exceeded
- Quick disconnect allows for tool-less replacement of LED engine from below ceiling
- 90 and 97 CRI
- 90 & 97CRI: L78 55,000 hours for 1000-2000 lumens, L90 55,000 for all other lumen output
- Color variation within 2-step MacAdam ellipses
- Available in 2400K, 2700K, 3000K, 3500K, 4000K and 5000K correlated color temperature (CCT)

Vividtune and High CRI
- 98 CRI and W2N: L70 55,000 hours
- D2W™ – dim-to-warm shifts CCT from 3000K to 1850K as fixture dims mimicking halogen sources.
- W2N - Tunable white CCT range 2700K to 6500K or 2000K to 5000K, 90 CRI. Standard
- **98 CRI** With a full-spectrum approach using broad-blue chip technology and special phosphor blends, Thrive is able to closely match the spectrum of the sun across all color temperatures. Benefits of the natural spectrum of the sun using Thrive include superior accurate color rendering, reduced eye strain, and a higher sense of emotional well-being.
- See dedicated specification sheet for more details.

Driver
- Standard 120-277V 0-10V dimming driver provides flicker-free dimming from 100% to 1%
- Optional 120V leading edge, <1% 0-10V, Fifth Light, DMX or Lutron®
- Remote driver option up to 100' based on driver selection
- Distributed low voltage power system combines power, lighting, and controls with ease of installation.

Emergency Option
- Provides 90 minutes of standby lighting, meeting most life safety codes for egress lighting
- Available Self-Test (self-diagnostic) with remote charge indicator and test switch
- Emergency Transfer Relay Device bypasses local control during a power outage
- UL 924 listed

Connected Lighting System Options
Two WaveLinx connected systems to choose from. Refer to WaveLinx system specifications and application guides for details.

WaveLinx Wireless System Tilemount Sensor Kit
- WaveLinx Wireless WPST tile mount sensor kit offers daylight dimming, PIR motion sensing, scene and zone configuration, automatic commissioning; and optional RLTS - Real Time Location Services available.

WaveLinx Lite System Tilemount Sensor Kit
- WaveLinx Lite WLST tile mount sensor kit offers daylight dimming and PIR motion sensing, scene and grouping configuration.

WaveLinx Tilemount Kits Application
- The WPST and WLST tilemount kits include a control module mounted on the luminaire junction box via 1/2" knock-out, and a tilemount sensor on 54-inch whip; for ceiling installation by direct-mount spring clips or via mounting bracket in octagon ceiling boxes.
- The WPST and WLST tilemount kits may be ordered as factory installed on the luminaire, or ordered separately as a field installed accessory kit.

Compliance
- EMI/RFI emissions per FCC 47CFR Part 18 Class B consumer limits
- RoHS compliant
- Photometric testing completed in accordance with IES LM-79
- LED life testing completed in accordance with IES LM-80 standards

Warranty
- Five year warranty www.cooperlighting.com/legal

Energy and Performance Data

D010 DRIVER ENERGY DATA

Series	250 lumen		500 lumen		800 lumen		1000 lumen		1500 lumen		2000 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V
Input Current (A)	0.029	0.017	0.061	0.032	0.085	0.041	0.084	0.042	0.135	0.063	0.189	0.084
Input Power (W)	3.45	3.87	7.33	7.78	10.15	10.52	10.04	10.43	16.17	16.56	22.58	22.63
In-rush (A)	2.1	8.5	3.7	8.5	3.6	8.3	3.6	8.4	2.3	9.5	2.1	9.7
Inrush duration (µs)	250	131	190	136	220	135	226	136	230	125	243	132
THDi (%)	7.21	16.92	7.82	10.78	5.57	9.63	7.78	9.24	4.75	9.93	8.03	7.44
PF	≥ 0.98	≥ 0.9	≥ 0.99	≥ 0.93	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.94	≥ 0.99	≥ 0.96

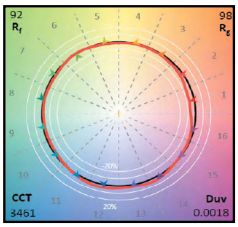
Series	2500 lumen		3000 lumen		3500 lumen		4000 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V	120V	277V	120V	277V
Input Current (A)	0.276	0.121	0.276	0.041	0.333	0.152	0.404	0.181
Input Power (W)	32.98	32.57	32	10.52	39.83	39.84	48.38	47.94
In-rush (A)	2.5	11.8	3.6	8.3	3.1	14.3	3.1	14.5
Inrush duration (µs)	215	111	220	135	200	94	197	95
THDi (%)	9.86	6.57	5.57	9.63	4.25	10.05	5.02	7.97
PF	≥ 0.99	≥ 0.97	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.94	≥ 0.99	≥ 0.95

Minimum starting temperature -30°C (-22°F)* (Nominal input 120-277VAC & 100% of rated output power)
Sound Rating: Class A standards

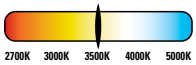
Notes:
Emergency Battery packs are rated for a minimum starting temperature of 0°C.

COLOR METRICS - TM-30-15 & CRI/CIE

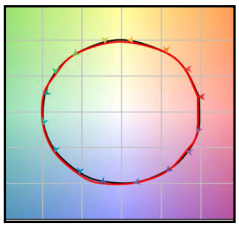
90 CRI Color Metric Summary - 3500K*



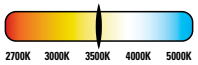
TM-30-15	Rf = 92
	Rg = 98
CRI/CIE	Ra = 92.2
	R9 = 51.4



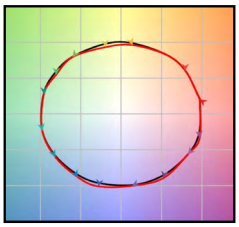
97 CRI Color Metric Summary - 2700K*



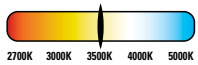
TM-30-15	Rf = 95
	Rg = 99.8
CRI/CIE	Ra = 92.2
	R9 = 85.8



97 CRI Color Metric Summary - 3000K*



TM-30-15	Rf = 93.9
	Rg = 100.2
CRI/CIE	Ra = 92.2
	R9 = 98.7



* Color values are based on haze reflector, other finishes and field results may vary.

Photometric Data

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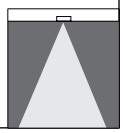
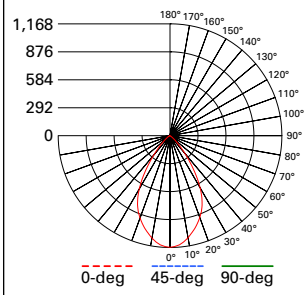
MEDIUM BEAM 50° CUTOFF 65° BEAM (H)

Test Number	P571636
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LBMH
Lumens	1178
Efficacy	74.6 Lm/W
SC	0.95
UGR	11.9

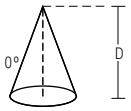


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	73	3.6	3.6
7'	23.8	6.6	6.6
9'	14.4	8.4	8.4
13'	6.9	12.2	12.2
16'	4.6	15	15

CANDELA TABLE

Degrees Vertical	Candela
0	1168
5	1147
15	1006
25	800
35	437
45	135
55	32
65	9
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

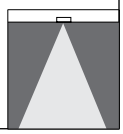
Zone	Lumens	% Fixture
0-30	752	63.8
0-40	1024	87
0-60	1165	98.9
0-90	1178	100
90-180	0	0
0-180	1178	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	55459
45	23472
55	6854
65	2587
75	854
85	0

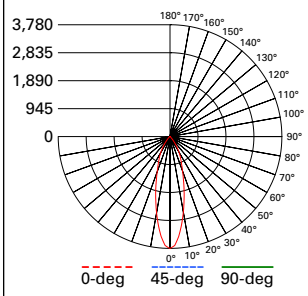
MEDIUM BEAM 50° CUTOFF 45° BEAM (LI)

Test Number	P571637
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LBMLI
Lumens	1469
Efficacy	93 Lm/W
SC	0.48
UGR	0



CANDLEPOWER DISTRIBUTION

Downlight



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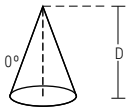


D	FC	L	W
4'	236.3	1.8	1.8
7'	77.2	3.2	3.2
9'	46.7	4.2	4.2
13'	22.4	6.2	6.2
16'	14.8	7.6	7.6

CANDELA TABLE

Degrees Vertical	Candela
0	3780
5	3389
15	1844
25	873
35	339
45	38
55	2
65	2
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

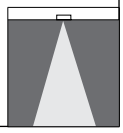
Zone	Lumens	% Fixture
0-30	1213	82.6
0-40	1428	97.2
0-60	1468	99.9
0-90	1469	100
90-180	0	0
0-180	1469	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	38008
45	6672
55	493
65	669
75	0
85	0

NARROW 55° BEAM (H)

Test Number	P571638
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LBNH
Lumens	979
Efficacy	62 Lm/W
SC	0.81
UGR	8.2



CANDLEPOWER DISTRIBUTION

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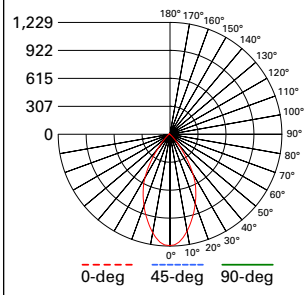
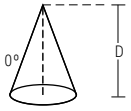


CONE OF LIGHT



D	FC	L	W
4'	76.8	3.2	3.2
7'	25.1	5.6	5.6
9'	15.2	7.2	7.2
13'	7.3	10.4	10.4
16'	4.8	12.8	12.8

CANDELA TABLE

Degrees Vertical	Candela
0	1229
5	1197
15	963
25	685
35	332
45	67
55	16
65	5
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

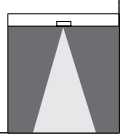
Zone	Lumens	% Fixture
0-30	692	70.7
0-40	899	91.8
0-60	972	99.2
0-90	979	100
90-180	0	0
0-180	979	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	39457
45	11710
55	3406
65	1541
75	854
85	0

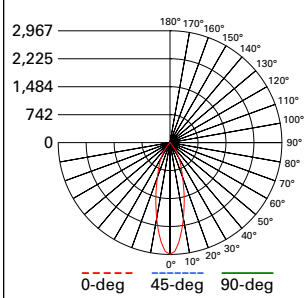
NARROW 30° BEAM (LI)

Test Number	P571639
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LBNLI
Lumens	1153
Efficacy	73 Lm/W
SC	0.48
UGR	0

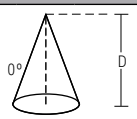


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	185.4	1.8	1.8
7'	60.6	3.2	3.2
9'	36.6	4.2	4.2
13'	17.6	6.2	6.2
16'	11.6	7.6	7.6

CANDELA TABLE

Degrees Vertical	Candela
0	2967
5	2660
15	1447
25	685
35	266
45	30
55	2
65	2
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	952	82.6
0-40	1121	97.2
0-60	1152	99.9
0-90	1153	100
90-180	0	0
0-180	1153	100

LUMINANCE

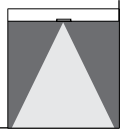
Average Candela Degrees	Average 0° Luminance
37	29831
45	5247
55	386
65	523
75	0
85	0

Photometric Data

View IES files

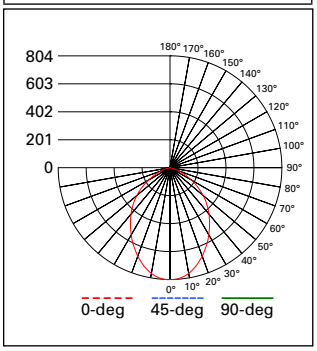
SHALLOW 85° BEAM (H)

Test Number	P571640
Housing	LE*4C15D010
Module	EU4B10209035
Trim	4LBSH
Lumens	1538
Efficacy	97.3 Lm/W
SC	1.06
UGR	26.5

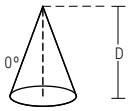


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	50.3	4.2	4.2
7'	16.4	7.4	7.4
9'	9.9	9.4	9.4
13'	4.8	13.6	13.6
16'	3.1	16.8	16.8

CANDELA TABLE

Degrees Vertical	Candela
0	804
5	798
15	730
25	618
35	496
45	376
55	246
65	120
75	29
85	0
90	0

ZONAL LUMEN SUMMARY

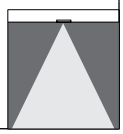
Zone	Lumens	% Fixture
0-30	565	36.7
0-40	875	56.9
0-60	1384	90
0-90	1538	100
90-180	0	0
0-180	1538	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	72577
45	65309
55	52605
65	34942
75	13670
85	0

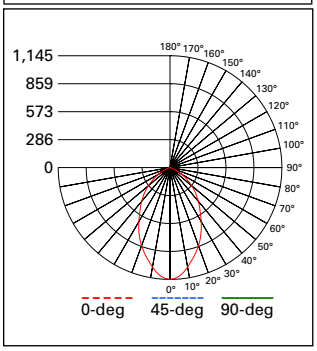
SHALLOW 65° BEAM (LI)

Test Number	P571641
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LBSLI
Lumens	1604
Efficacy	101.5 Lm/W
SC	0.91
UGR	23.9

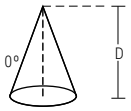


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	71.6	3.6	3.6
7'	23.4	6.2	6.2
9'	14.1	8.2	8.2
13'	6.8	11.8	11.8
16'	4.5	14.4	14.4

CANDELA TABLE

Degrees Vertical	Candela
0	1145
5	1115
15	945
25	749
35	534
45	371
55	208
65	73
75	4
85	0
90	0

ZONAL LUMEN SUMMARY

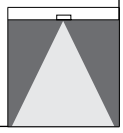
Zone	Lumens	% Fixture
0-30	712	44.4
0-40	1048	65.3
0-60	1520	94.8
0-90	1604	100
90-180	0	0
0-180	1604	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	77201
45	64475
55	44508
65	21163
75	1709
85	0

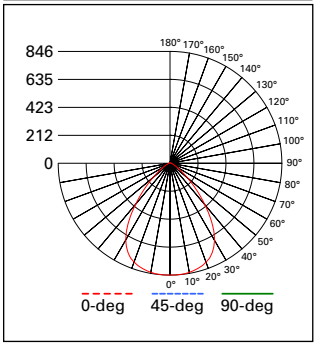
WIDE 80° BEAM (H)

Test Number	P571642
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LBWH
Lumens	1309
Efficacy	82.8 Lm/W
SC	1.18
UGR	17.9

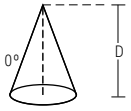


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	52.7	4.6	4.6
7'	17.2	8.2	8.2
9'	10.4	10.4	10.4
13'	5	15.2	15.2
16'	3.3	18.8	18.8

CANDELA TABLE

Degrees Vertical	Candela
0	844
5	844
15	821
25	748
35	547
45	265
55	84
65	23
75	7
85	0
90	0

ZONAL LUMEN SUMMARY

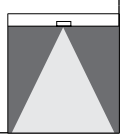
Zone	Lumens	% Fixture
0-30	653	49.9
0-40	991	75.7
0-60	1276	97.5
0-90	1309	100
90-180	0	0
0-180	1309	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	75186
45	45989
55	17885
65	6715
75	3370
85	0

WIDE 80° BEAM (LI)

Test Number	P571643
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LBWLI
Lumens	1551
Efficacy	98.2 Lm/W
SC	1.29
UGR	6.9



CANDLEPOWER DISTRIBUTION

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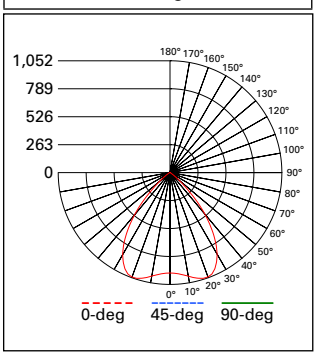
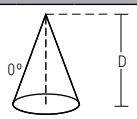


CONE OF LIGHT



D	FC	L	W
4'	59.5	5	5
7'	19.4	9	9
9'	11.8	11.6	11.6
13'	5.6	16.6	16.6
16'	3.7	20.6	20.6

CANDELA TABLE

Degrees Vertical	Candela
0	950
5	963
15	1036
25	1005
35	723
45	279
55	28
65	4
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	844	54.4
0-40	1289	83.1
0-60	1546	99.7
0-90	1551	100
90-180	0	0
0-180	1551	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	-
45	-
55	-
65	-
75	-
85	-

Photometric Data

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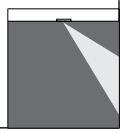
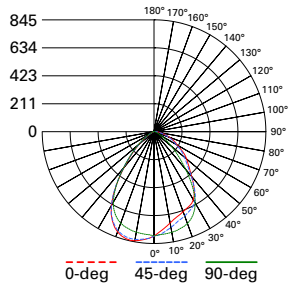
SINGLE WALL WASH (H)

Test Number	P571644
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LCSWH
Lumens	1390
Efficacy	88 Lm/W
SC	1.17
UGR	29.6

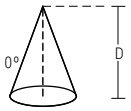


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	51	4.4	4.6
7'	16.6	7.9	8
9'	10.1	10.1	10.2
13'	4.8	14.7	15
16'	3.2	18.1	18.4

CANDELA TABLE

Degrees Vertical	Candela
0	793
5	746
15	669
25	625
35	527
45	371
55	262
65	159
75	74
85	17
90	0

ZONAL LUMEN SUMMARY

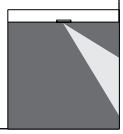
Zone	Lumens	% Fixture
0-30	608	43.8
0-40	928	66.7
0-60	1283	92.3
0-90	1390	100
90-180	0	0
0-180	1390	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	75835
45	64441
55	56032
65	46337
75	34936
85	24527

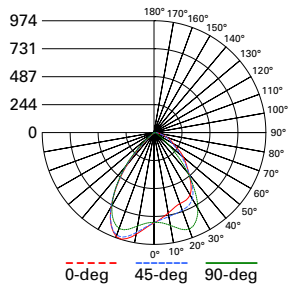
SINGLE WALL WASH (LI)

Test Number	P571645
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LCSWLI
Lumens	1445
Efficacy	91.5 Lm/W
SC	1.3
UGR	28.3



CANDLEPOWER DISTRIBUTION

Downlight



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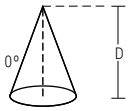


D	FC	L	W
4'	54.2	4.5	4.8
7'	17.7	8	8.6
9'	10.7	10.3	11
13'	5.1	14.9	16
16'	3.4	18.4	19.6

CANDELA TABLE

Degrees Vertical	Candela
0	783
5	745
15	673
25	648
35	548
45	384
55	235
65	143
75	57
85	10
90	0

ZONAL LUMEN SUMMARY

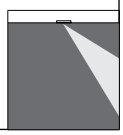
Zone	Lumens	% Fixture
0-30	680	47.1
0-40	1041	72.1
0-60	1362	94.2
0-90	1445	100
90-180	0	0
0-180	1445	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	78745
45	66786
55	50356
65	41599
75	27151
85	14378

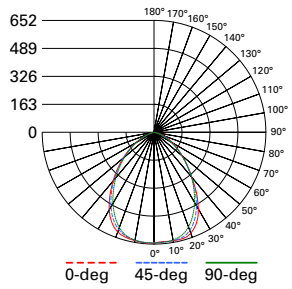
LENSED WALL WASH (LI)

Test Number	P571646
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LBLWWLI
Lumens	1246
Efficacy	78.9 Lm/W
SC	1.12
UGR	26.3



CANDLEPOWER DISTRIBUTION

Downlight



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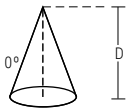


D	FC	L	W
4'	40.7	4.6	4.4
7'	13.3	8.2	7.8
9'	8	10.6	10
13'	3.8	15.4	14.4
16'	2.5	19	17.8

CANDELA TABLE

Degrees Vertical	Candela
0	650
5	644
15	647
25	591
35	439
45	278
55	174
65	99
75	42
85	3
90	0

ZONAL LUMEN SUMMARY

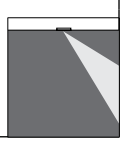
Zone	Lumens	% Fixture
0-30	499	40
0-40	766	61.5
0-60	1139	91.4
0-90	1246	100
90-180	0	0
0-180	1246	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	61806
45	48248
55	37226
65	28866
75	19936
85	4088

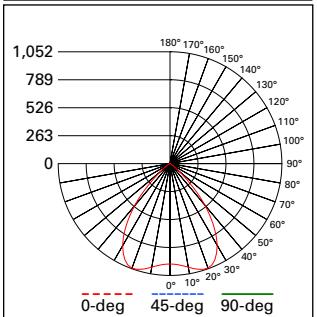
LENSED WALL WASH (H)

Test Number	P571647
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LBLWWH
Lumens	1196
Efficacy	75.7 Lm/W
SC	1.09
UGR	26.5

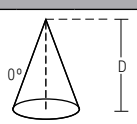


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	39.7	4.5	4.2
7'	13	8	7.6
9'	7.8	10.2	9.8
13'	3.8	14.8	14
16'	2.5	18.3	17.4

CANDELA TABLE

Degrees Vertical	Candela
0	635
5	639
15	639
25	586
35	441
45	280
55	174
65	100
75	43
85	4
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	471	39.4
0-40	724	60.5
0-60	1084	90.6
0-90	1196	100
90-180	0	0
0-180	1196	100

LUMINANCE

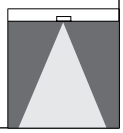
Average Candela Degrees	Average 0° Luminance
37	62135
45	48734
55	37269
65	29099
75	20268
85	5497

Photometric Data

View IES files

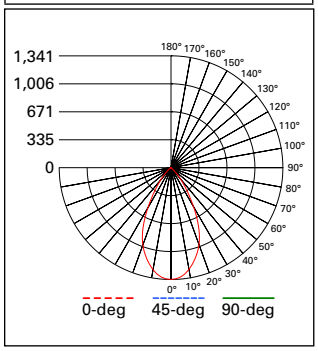
MEDIUM BEAM 45° CUTOFF 55° BEAM (H)

Test Number	P571648
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LBMDH
Lumens	1113
Efficacy	70.4 Lm/W
SC	0.86
UGR	9.5



CANDLEPOWER DISTRIBUTION

Downlight



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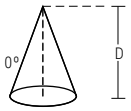


D	FC	L	W
4'	83.8	3.4	3.4
7'	27.4	6	6
9'	16.6	7.6	7.6
13'	7.9	11	11
16'	5.2	13.6	13.6

CANDELA TABLE

Degrees Vertical	Candela
0	1341
5	1318
15	1127
25	791
35	337
45	91
55	20
65	7
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

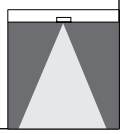
Zone	Lumens	% Fixture
0-30	793	71.3
0-40	1008	90.6
0-60	1103	99.1
0-90	1113	100
90-180	0	0
0-180	1113	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	41780
45	15758
55	4284
65	2064
75	1044
85	423

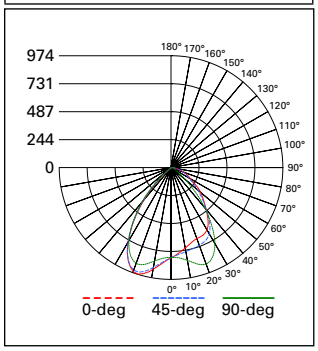
MEDIUM BEAM 45° CUTOFF 50° BEAM (LI)

Test Number	P571649
Housing	LE*4C15D010
Module	EU4C10209035
Trim	4LBMDLI
Lumens	1294
Efficacy	81.9 Lm/W
SC	0.84
UGR	0.4

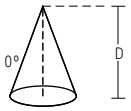


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	108.2	3.2	3.2
7'	35.3	5.6	5.6
9'	21.4	7.4	7.4
13'	10.2	10.6	10.6
16'	6.8	13.2	13.2

CANDELA TABLE

Degrees Vertical	Candela
0	1700
5	1751
15	1545
25	945
35	323
45	47
55	6
65	2
75	1
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	1023	79.1
0-40	1243	96
0-60	1291	99.8
0-90	1294	100
90-180	0	0
0-180	1294	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	36556
45	8096
55	1199
65	640
75	285
85	0

Photometric Multipliers (Nominal Lumen Values)

250 Lumen	500 Lumen	800 Lumen	1000 Lumen	1500 Lumen	2000 Lumen	2500 Lumen	3000 Lumen	3500 Lumen
0.22	0.42	0.57	0.65	1.00	1.29	1.62	1.90	2.25

4000 Lumen	4500 Lumen	5000 Lumen	5500 Lumen	6000 Lumen	6500 Lumen	7000 Lumen	7500 Lumen
2.61	3.02	3.42	3.82	4.13	4.32	4.54	5.34

Multipliers for relative lumen values with other series models.

CCT Multipliers – 90CRI

2400K	2700K	3000K	3500K	4000K	5000K
0.912	0.949	0.986	1	1.001	1.022

Multipliers for relative lumen values with other series color temperatures.

CCT Multipliers – 97CRI

2700K	3000K	3500K	4000K	5000K
0.889	0.955	1	1.016	1.07

Multipliers for relative lumen values with other series color temperatures.

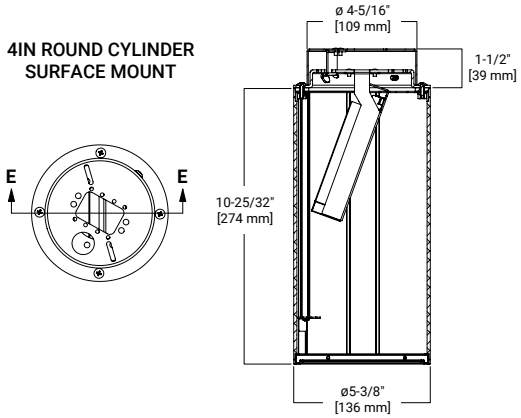
Color Finish Multipliers (*from H = Semi Specular Clear*)

Finish code	LI	H	WMH	WH	GPH	B	MW
Finish	Specular Clear	Semi-Specular Clear	Warm Haze	Wheat	Graphite Haze	Specular Black	Matte White
Multiplier	1.25	1.00	1.02	1.02	0.72	0.55	0.95

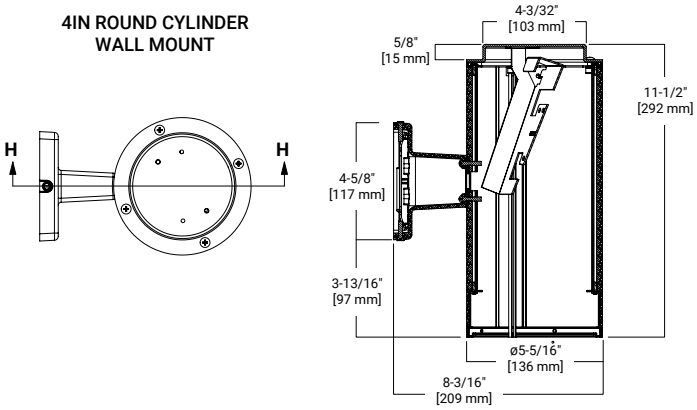
Multipliers for relative lumen values with other color finishes.

Dimensional and Mounting Details

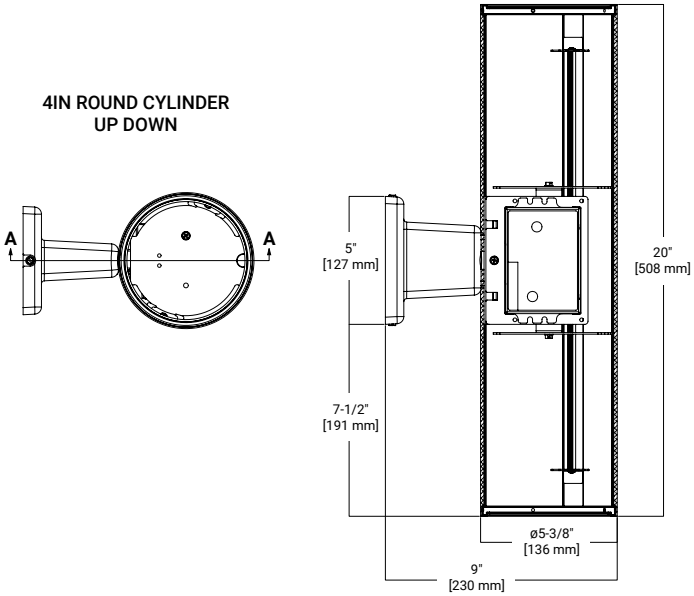
4IN ROUND CYLINDER
SURFACE MOUNT



4IN ROUND CYLINDER
WALL MOUNT

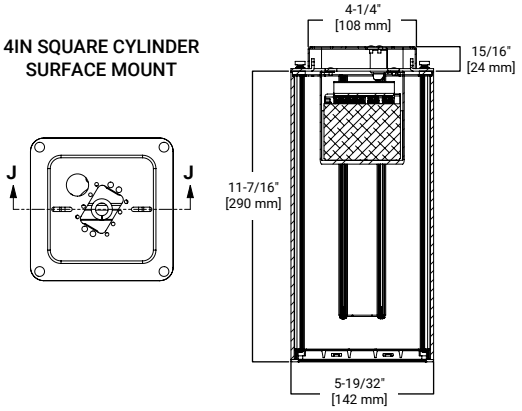


4IN ROUND CYLINDER
UP DOWN

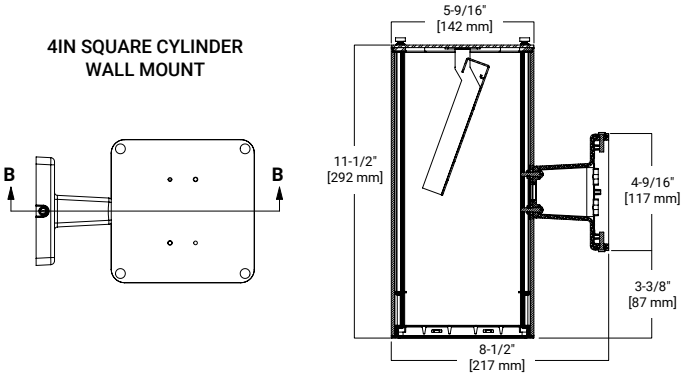


Dimensional and Mounting Details

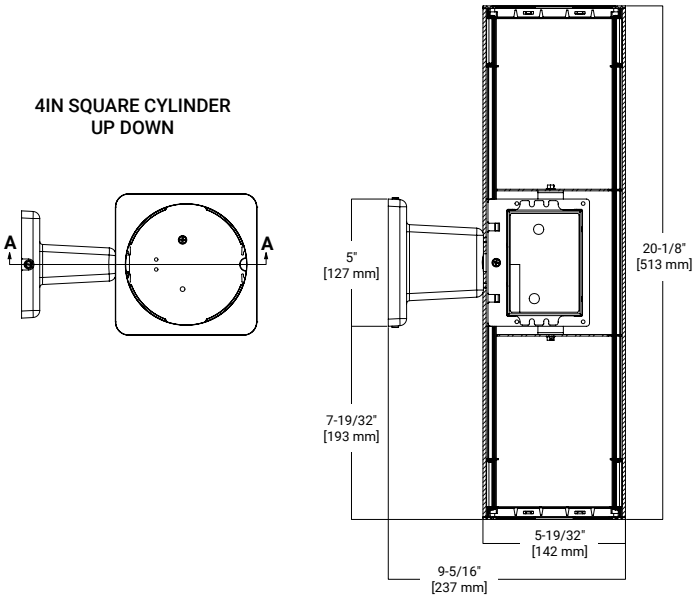
4IN SQUARE CYLINDER
SURFACE MOUNT



4IN SQUARE CYLINDER
WALL MOUNT

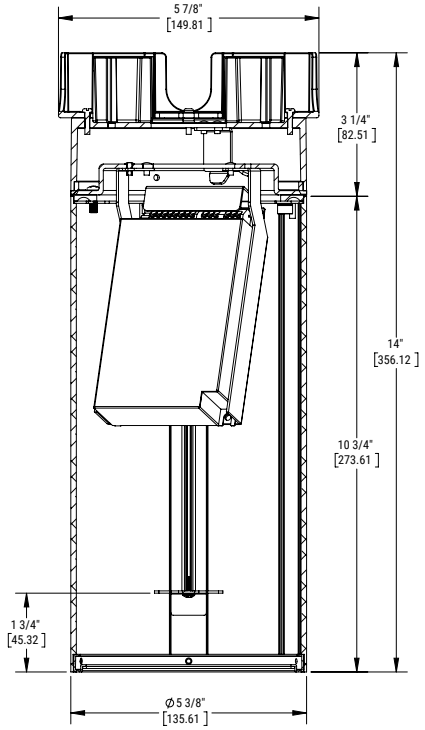


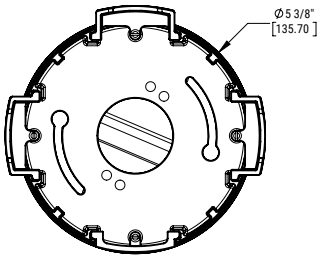
4IN SQUARE CYLINDER
UP DOWN



Dimensional and Mounting Details

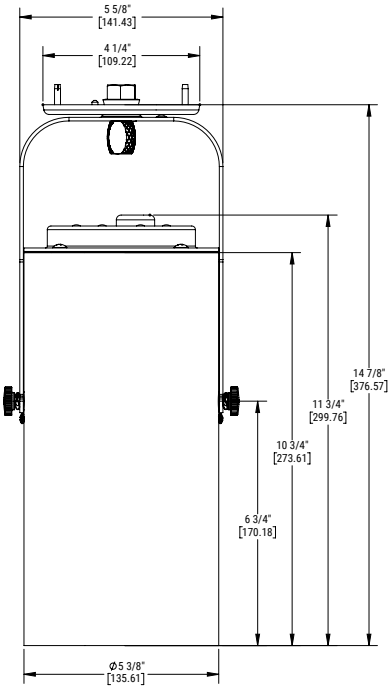
4" ROUND CONDUIT CANOPY



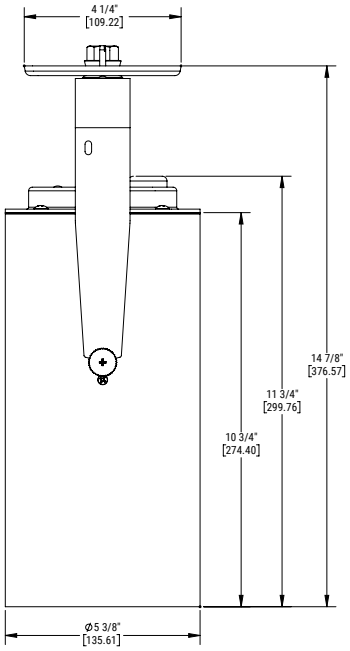


4" ROUND, YOKE MOUNT

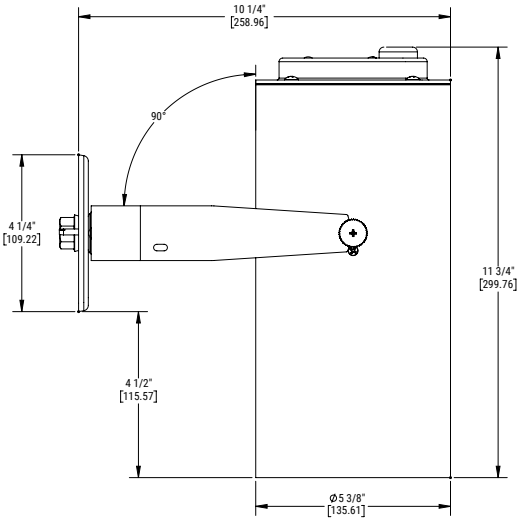
FRONT VIEW



SIDE VIEW @ 0° TILT

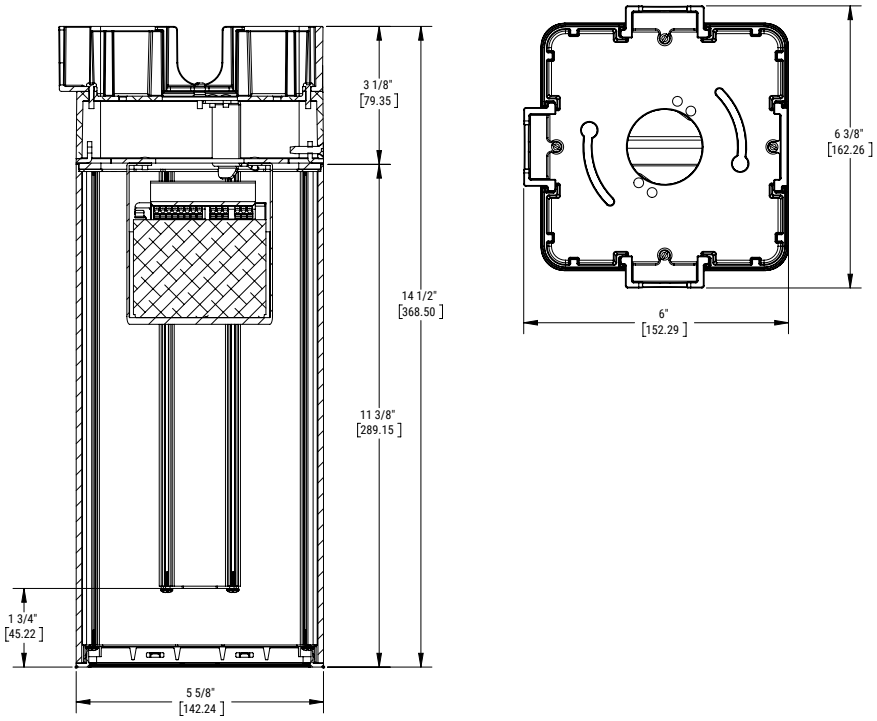


SIDE VIEW FULL TILT



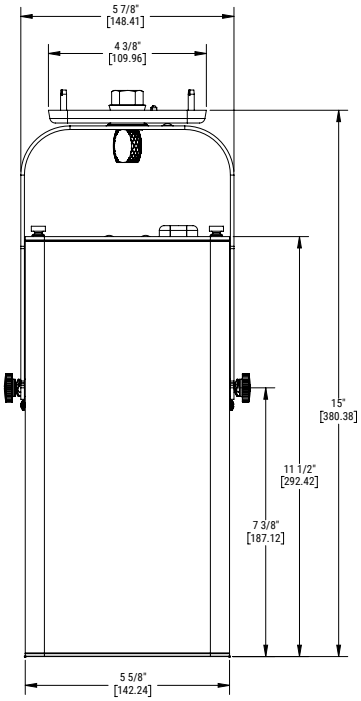
Dimensional and Mounting Details

4” SQUARE CONDUIT CANOPY

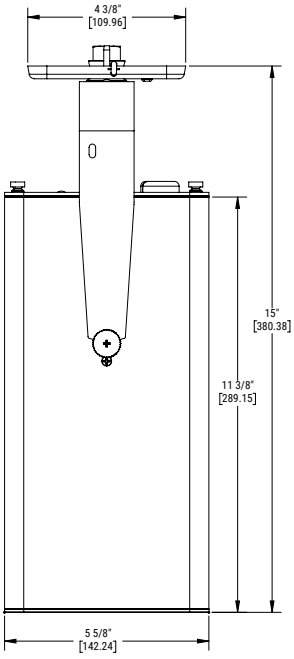


4" SQUARE YOKE MOUNT

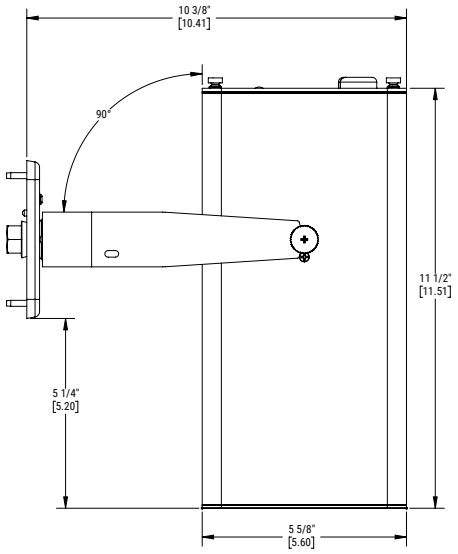
FRONT VIEW



SIDE VIEW @ 0° TILT



SIDE VIEW FULL TILT



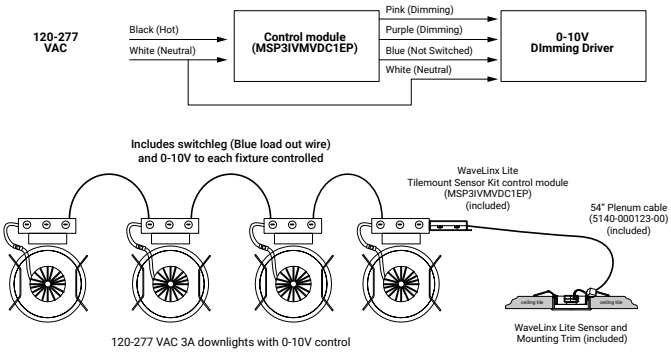
Connected Solutions

WaveLinx LITE - WLST Tilemount Sensor

- Intuitive Android™ or Apple® iOS® app for basic system code compliant set up and configuration via Bluetooth
- Up to 28 unique areas per project site (WaveLinx LITE Bluetooth network)
- Up to 50 devices for an area, any one of 16 control zones, up to 6 occupancy sets, and custom lighting scenes
- Automatic occupancy or vacancy, sensor sensitivity, daylight dimming, etc. configurable through the app
- Refer to the WaveLinx system specifications for details

Network Security | Manual Dimmer | Occupancy Sensor | Daylighting Control | Manually Switched ON/OFF | Tuning Control | Lumen Maintenance Control | Scenes

WaveLinx LITE WLST Tilemount Wiring Diagram



WaveLinx LITE Bluetooth Enabled System

WaveLinx PRO Wireless – WPST Tilemount Sensor

- WaveLinx PRO Wireless functionality configures zones and customizes settings from one secure mobile app
- Automatic code commissioning that meets the strictest codes
- Fixtures and sensors integrate with Wireless Area Controller, Wall Stations, and Control Devices
- Stand-Alone Offices or Entire Building Network Installations

Downlights with tilemount sensor wireless communication
Highly efficient LED fixtures

WaveLinx Area Controller
Provides centralized coordination of multiple area control options

Wireless Wall Station/Receptacle
Provides customized wireless control of each area

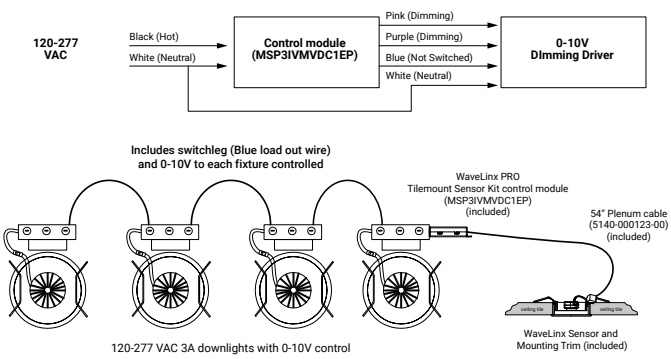
Mobile Applications
Provides personalized, local control from a tablet or smartphone

WaveLinx mobile app settings

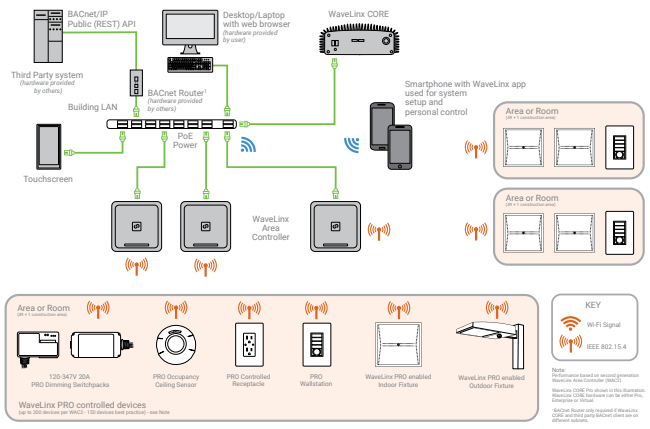
Manual Dimmer | Occupancy Sensor | Lumen Maintenance Control | Daylighting Control

Receptacle Control | Tuning Control | Scheduling | Manually Switched ON/OFF | Demand Response

WaveLinx PRO WPST Tilemount Wiring Diagram



WaveLinx CORE Building Management Integration



Connected Solutions

WaveLinx PRO Wireless Node - WPN

- WaveLinx Wireless functionality configures zones and customizes settings from one secure mobile app
- Automatic code commissioning that meets the strictest codes
- Fixtures and sensors integrate with WaveLinx Area Controller, Wall Stations, and Control Devices
- Stand-Alone Offices or Entire Building Network Installations

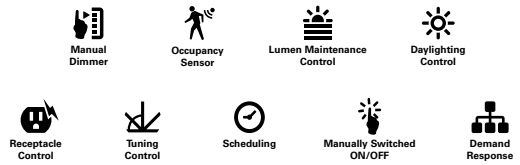
Downlights with wireless communication
Highly efficient LED fixtures

WaveLinx Area Controller
Provides centralized coordination of multiple area control options

Wireless Wall Station/Receptacle
Provides customized wireless control of each area

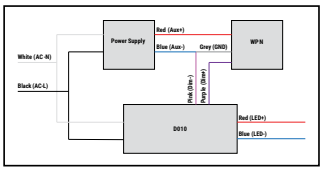
Mobile Applications
Provides personalized, local control from a tablet or smartphone

WaveLinx mobile app settings

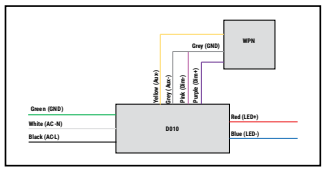


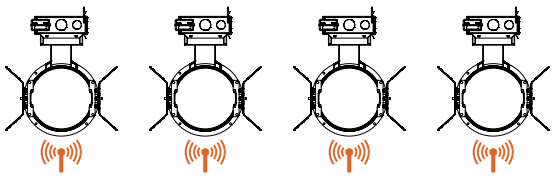
WaveLinx PRO Wireless Node (WPN) Wiring Diagram

For 0-10V drivers 250 lumens and Tunable White



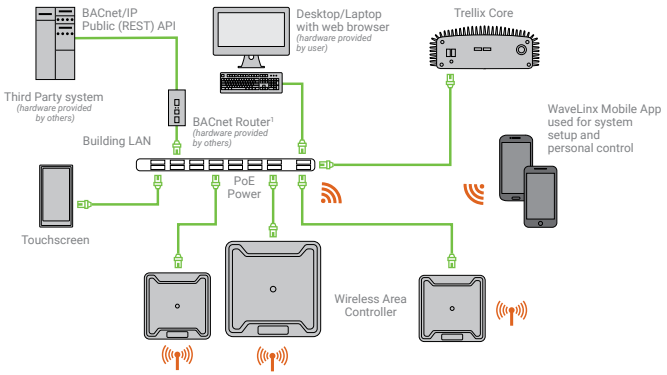
For 0-10V drivers 500 lumens and over





120-277 VAC 3A downlights with 0-10V control

WaveLinx CORE Building Management Integration



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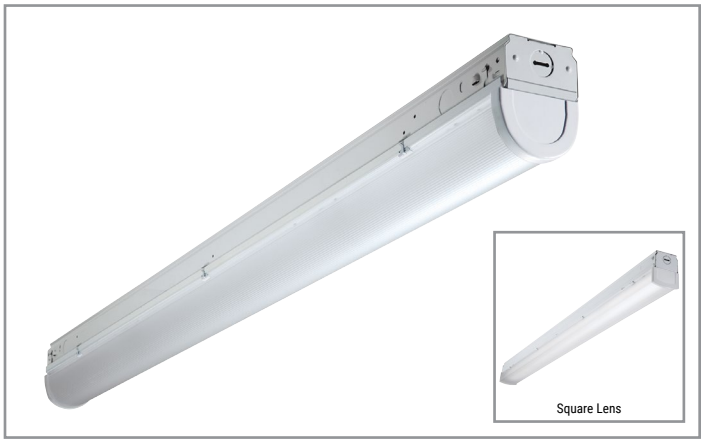
Specifications and dimensions subject to change without notice.

Project		Catalog #		Type	
Prepared by		Notes		Date	



Metalux

SNLED Lensed

Lensed LED Strip Round and Square Lens

Typical Applications

Storage / Utility • Coves • Display Cases • Task and General Area

Interactive Menu

- Order Information page 2
- Photometric Data page 3
- Connected Systems page 3
- Product Warranty

Product Certification

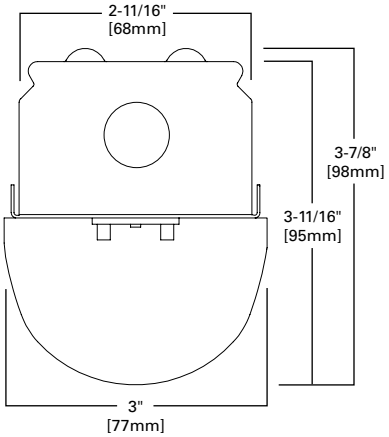
Product Features

Top Product Features

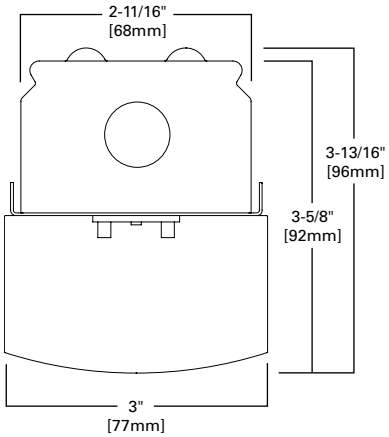
- Standard (SL) and High lumen/High Efficacy (HL) packages
- High efficiencies - up to 153 LPW
- Three different lens types for optical control
- Two different reflectors for precise distribution control
- Available CCT: 3000K, 3500K, 4000K and 5000K
- Minimum CRI of 80; 90 CRI available
- Options to meet Trade Agreements Act requirements

Dimensional Details

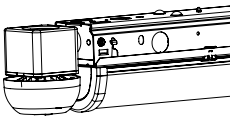
Round Lens



Square Lens



ZW-SWPD3 Sidecar



additional product diagrams

Order Information

SAMPLE ORDER NUMBER: **4SNLED-LD5-46SL-LN-UNV-L835-CD1-U**
8TSNLED-LD5-200HL-SLN-UNV-EL7W-L840-CD2-U

Domestic Preferences [19]	Length			Series	Lamp Type
[Blank]=Standard **TAA**=Trade Agreements Act	**2**=2 ft.	**4**=4 ft.	**8T**=8 ft.	**SNLED**=Commercial LED Striplight [1]	**LD5**=LED 5.0

LED Lumen Packages [2]

2 ft. Round Lens		
LC	**LN**	**LW**
18SL	18SL	16SL
22SL	22SL	20SL
26SL	26SL	23SL
34HL	32HL	30HL
Clear	Semi-frost narrow	Full frost wide

4 ft. Round Lens		
LC	**LN**	**LW**
18SL	18SL	16SL
22SL	22SL	20SL
26SL	26SL	23SL
30SL	30SL	27SL
34SL	34SL	30SL
37SL	37SL	33SL
41SL	41SL	37SL
46SL	46SL	41SL
49SL	53SL	44SL
52SL	56SL	47SL
56SL	61SL	50SL
63SL	64SL	56SL
66SL	50HL	58SL
52HL	54HL	44HL
55HL	60HL	48HL
60HL	74HL	54HL
76HL		65HL
Clear	Semi-frost narrow	Full frost wide

8 ft. Round Lens		
LC	**LN**	**LW**
60SL	60SL	54SL
68SL	68SL	61SL
75SL	75SL	67SL
83SL	83SL	74SL
90SL	91SL	81SL
98SL	98SL	88SL
105SL [3]	106SL	95SL
130HL [3]	130HL [3]	110HL
170HL [3]	170HL [3]	150HL
Clear	Semi-frost narrow	Full frost wide

SL denotes standard lumen output. HL denotes high lumen output. Additional LEDs to obtain lumen package.
For comparable lumen packages, HL efficacy is greater than SL efficacy.
26SL: 2600 delivered lumens, standard lumen output
170HL: 17000 delivered lumens, high output.

2 ft. Square Lens		
SLC	**SLN**	**SLW**
19SL	19SL	16SL
24SL	24SL	20SL
27SL	27SL	22SL
37HL	37HL	30HL
48HL	48HL	41HL
Clear	Semi-frost narrow	Full frost wide

4 ft. Square Lens		
SLC	**SLN**	**SLW**
19SL	19SL	15SL
23SL	23SL	19SL
27SL	27SL	22SL
30SL	30SL	25SL
35SL	35SL	29SL
39SL	39SL	32SL
42SL	42SL	35SL
47SL	46SL	39SL
50SL	50SL	41SL
54SL	54SL	45SL
58SL	58SL	48SL
63SL	63SL	52SL
65SL	65SL	54SL
77SL	78SL	64SL
85SL	85SL	70SL
54HL	54HL	46HL
57HL	57HL	48HL
62HL	62HL	52HL
68HL	68HL	57HL
82HL	82HL	69HL
97HL	97HL	81HL
Clear	Semi-frost narrow	Full frost wide

8 ft. Square Lens		
SLC	**SLN**	**SLW**
60SL	64SL	50SL
70SL	70SL	58SL
78SL	77SL	64SL
84SL	84SL	70SL
93SL	93SL	77SL
100SL	100SL	83SL
108SL	108SL	90SL
116SL	116SL	96SL
125SL	125SL	104SL
131SL	130SL	108SL
130HL	130HL	130HL
170HL [3]	170HL [3]	170HL [3]
200HL	200HL	200HL
Clear	Semi-frost narrow	Full frost wide

Same notes apply as round (column on left)

Lens

Round
LC=Clear Lens
LN=Semi-Frost Lens - Narrow
LW=Full Frost Lens - Wide

Square
SLC=Square / Flat Clear Lens
SLN=Square / Flat Semi - Frost Lens - Narrow
SLW=Square / Flat Full Frost Lens - Wide

Voltage

UNV=Universal Voltage 120-277
347=347V [5], [6], [7]
480=480V [4]

Options

Emergency
EL7W=7-watt, 120V-277V emergency battery pack installed [8], [10], [21]
EL14W=14-watt 120V-277V emergency battery pack installed [8], [10], [21]
GTR2=Bodine Generator Transfer Relay [11]
ETRD=Iota Emergency Transfer Relay with dimming control [11], [21]

Wiring
PI/CPI=Plug in and cross over plug in options [13]
PC6/515P=(NEMA 5-15P) 6 ft. Cord with NEMA Straight Plug [12], [13]
PC6/L715=(NEMA L7-15P) 6 ft. Cord with NEMA Twist Plug [12], [13]

Motion Sensors [14]
LB-ERMS360=360° Low Bay Motion Sensor - End of Row
LB-MRMS360=360° Low Bay Motion Sensor - Middle of Row
HB-ERMS360=360° High Bay Motion Sensor - End of Row [9]
HB-MRMS360=360° High Bay Motion Sensor - Middle of Row [9]
ZW-SWPD3=WaveLinx Wireless Sensor, Sidecar mount, with 1200 sq ft. coverage
WLS4=WaveLinx Lite Wireless Integrated Sensor, 15'–40' Mounting Height [20]

Color Temp / CCT

CCT/CRI
L830=3000K, 80 CRI
L835=3500K, 80 CRI
L840=4000K, 80 CRI
L850=5000K, 80 CRI
L930=3000K, 90 CRI
L935=3500K, 90 CRI
L940=4000K, 90 CRI
L950=5000K, 90 CRI

Drive Type

CD=0-10V Dimming Driver (10%-100% Dimming)
HCD=0-10V Dimming Driver (1%-100% Dimming)
SD=Step-dim (Bi Level) [15]
5LTD=Fifth Light (DALI) Driver [15], [16]

No.of Drivers

1=1 Driver
2=2 Drivers

Paint Finish

[blank]=Standard White
BLK=PAF Black [17]

Packaging

U=Unit Pack

Accessories (Order Separately) [18]

AYC-Chain/Set=36" Chain Hanger (Use 1 set per fixture)
SCF=Fixed Stem Set (Specify Length)
SCS=Swivel Stem Set (Specify Length)
SCA=Adjustable 48" Stem Set
EYE-CHAIN/SET-B=Eye Bolt Chain (Use 1 set per fixture)
WG/SNF-2FT=2 ft Wire Guard
WG/SNF-4FT=4 ft Wire Guard
A1B/Spacer-U=Spacer 1-1/2" to 2-1/2" from ceiling (Use 2 per fixture)
TOGGLE=Single Toggle No. 2 (Specify Length)
Y-TOGGLE-__-2PK=(2) Y-Toggle Cable Kits (Specify 10 or 30 for length in feet)
GRP-SNF-U=Gripper Hanger
CLC-SNLED-EXT-B=SNLED Long Row Aligner Extension

Round Replacement Lenses
SNLED-LENS-LW-2FT-U= Replacement Lens 2 ft, Full Frost
SNLED-LENS-LN-2FT-U= Replacement Lens 2 ft, Semi Frost
SNLED-LENS-LC-2FT-U= Replacement Lens 2 ft, Clear
SNLED-LENS-LW-4FT-U= Replacement Lens 4 ft, Full Frost
SNLED-LENS-LN-4FT-U= Replacement Lens 4 ft, Semi Frost
SNLED-LENS-LC-4FT-U= Replacement Lens 4 ft, Clear

Square Replacement Lenses
SNLED-SQLENS-SLW-2FT-U= Replacement Lens 2 ft, Full Frost
SNLED-SQLENS-SLN-2FT-U= Replacement Lens 2 ft, Semi Frost
SNLED-SQLENS-SLC-2FT-U= Replacement Lens 2 ft, Clear
SNLED-SQLENS-SLW-4FT-U= Replacement Lens 4 ft, Full Frost
SNLED-SQLENS-SLN-4FT-U= Replacement Lens 4 ft, Semi Frost
SNLED-SQLENS-SLC-4FT-U= Replacement Lens 4 ft, Clear

Notes: (1) DesignLights Consortium® Qualified and classified for both DLC Standard and DLC Premium, refer to www.designlights.org for details. (2) Nominal lumen values. See table for value and fixture length. (3) DALI and Step-dim versions require two drivers. (4) 4 ft. and 8 ft. only. (5) 347V CD driver is limited to 50W max output before requiring 2 drivers (no 85W 347V solution). (6) 347 SD Driver require qty 2 transformers for Dual switch legs can not offer with EBP due to space requirements for 3 ed transformer for EBP charge circuit.(7) All other drivers at 347V requires single transformer for Driver. If EBP is included, would require second transformer THD an PF affected by transformer (no DLC). (8) 4 ft. and 8 ft. only. (9) Motion Sensor offers dimmability. (10) With integral test switch/ indicator/laser test. For approximate delivered lumens multiply the lumens per watt of the desired fixture by the wattage of the emergency battery pack (100 lm/W x 7=700 lumens). IES-format photometry for luminaire under emergency operation available. (11) Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others). GTR2 and ETR2 options include 2 relays on fixtures with dimming drivers. ETRD option only requires one relay when used on a dimming fixture. Must specify voltage as 120V or 277V when ordering these devices. (12) Most common C&P shown. Must specify location for cord. All "end" locations will be on the end with sensor installed. (13) Consult tech support on numerous options for this feature. (14) Sensors provided in separate externally mounted enclosure. See SRL spec sheet for fully integrated/connected sensors. (15) 4 ft. and 8 ft. only. (16) For a complete listing of Fifth Light products, visit www.cooperlighting.com (17) Black fixture and lens ends. Refer to Finish multiplier table for performance (page 3). (18) Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information. (19) Only product configurations with this designated prefix are built to be compliant with the Trade Agreements Act of 1979 (TAA). Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements. (20) WaveLinx Lite devices are not currently compatible with the WaveLinx Pro Wireless Area Controller. (21) Emergency component is UL924 classified.

Product Specifications

Construction
- Die-formed of cold rolled steel with numerous knockouts for easy installation
- Groove for Tong Hanger
- Convertible end plate for continuous row alignment
- Channel/wireway cover secured with sheet metal screws
- Surface, pendant or stem mounting

Controls
- 0-10V dimming drivers to 10% or to 1% options
- Step-dimming option
- Fifth Light DALI 2.0 driver option

Electrical
- Long-life LED system with electrical driver for optimal performance
- LED's available in 3000K, 3500K, 4000K or 5000K with CRI of 80 standard or optional 90 CRI
- TM21 rating of L87>60,000 hours
- Electronic drivers available for 120-277V, 347V and 480 applications
- Operating temperature of -20°C to 40°C; Ideal for cold storage environments

Emergency Battery Pack Option
- Optional 120V-277V integral emergency battery pack available in 7W or 14W
- 7-watt battery provides approximately 900 lumens; 14-watt battery approximately 1800 lumens depending on efficacy
- 90-minute backup period for code compliance
- Test switch with laser pointer allows safe testing from floor
- Patented EZ Key prevents accidental discharge during construction
- Generator transfer options available

Finish
- Multi-stage, iron phosphate pretreatment
- Highly reflective paint after fabrication
- Standard baked white enamel finish

Shielding
- Three round lensed optical distributions available: Clear with linear ribs (LC), semi-frost for narrow distribution (LN) and full frost for wide distribution (LW)
- Three square lensed optical distributions available: clear with linear ribs (SLC), semi-frost for narrow distribution (SLN) and full frost for wide distribution (SLW)

Compliance
- cULus Listed for damp locations
- RoHS compliant
- State of California Title 24 high efficacy luminaire
- DesignLights Consortium® Qualified and classified for DLC Standard and DLC Premium (refer to www.designlights.org)
- Suitable for closet use when installed to NEC 410.16 spacings standards

Warranty
- Five year warranty

WaveLinx Lite devices are not currently compatible with the WaveLinx Pro Wireless Area Controller

Control Systems
- WaveLinx Wireless
- WaveLinx Wired
- WaveLinx Lite

Connected Systems CLICK HERE

Photometric Data

View IES files

Energy and Performance Data

CCT Table

Approximate Color Temperature Multiplier	
2700K	.93
3000K	.98
3500K	1.0
4000K	1.02
5000K	1.02

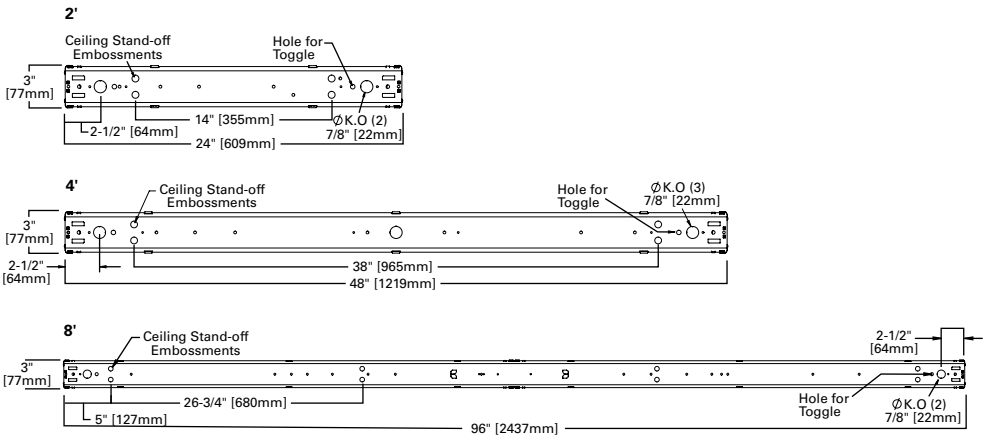
CRI

Lumen multiplier (80CRI to 90CRI)			
3000K	3500K	4000K	5000K
0.805	0.840	0.846	0.901

Shipping Data

Length	Wt.
2 ft.	4.3 lbs.
4 ft.	8.2 lbs.
8 ft.	15.1 lbs.

Dimensional and Mounting Details



Energy and Performance Data

Wattage: Round Clear Lens

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Clear Lens (LC)	Standard	2 ft.	2SNLED-LD5-18SL-LC-UNV-L8XX-CD1-U	1960	14	137.4
Clear Lens (LC)	Standard	2 ft.	2SNLED-LD5-22SL-LC-UNV-L8XX-CD1-U	2420	18	133.7
Clear Lens (LC)	Standard	2 ft.	2SNLED-LD5-26SL-LC-UNV-L8XX-CD1-U	2747	21	131.1
Clear Lens (LC)	High	2 ft.	2SNLED-LD5-34HL-LC-UNV-L8XX-CD1-U	3487	27	131.2
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-18SL-LC-UNV-L8XX-CD1-U	1890	13	145.0
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-22SL-LC-UNV-L8XX-CD1-U	2344	16	146.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-26SL-LC-UNV-L8XX-CD1-U	2699	18	146.3
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-30SL-LC-UNV-L8XX-CD1-U	3077	21	145.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-34SL-LC-UNV-L8XX-CD1-U	3567	25	143.3
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-37SL-LC-UNV-L8XX-CD1-U	3924	28	141.6
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-41SL-LC-UNV-L8XX-CD1-U	4269	31	139.6
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-46SL-LC-UNV-L8XX-CD1-U	4718	35	136.8
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-49SL-LC-UNV-L8XX-CD1-U	5051	38	134.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-52SL-LC-UNV-L8XX-CD1-U	5478	41	133.3
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-56SL-LC-UNV-L8XX-CD1-U	5880	46	127.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-63SL-LC-UNV-L8XX-CD1-U	6358	52	123.1
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-66SL-LC-UNV-L8XX-CD1-U	6628	55	120.2
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-52HL-LC-UNV-L8XX-CD1-U	5171	37	139.5
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-55HL-LC-UNV-L8XX-CD1-U	5409	39	138.5
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-60HL-LC-UNV-L8XX-CD1-U	5893	43	136.7
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-76HL-LC-UNV-L8XX-CD1-U	7774	62	125.1
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-60SL-LC-UNV-L8XX-CD1-U	6154	42	145.4
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-68SL-LC-UNV-L8XX-CD1-U	7134	50	143.3
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-75SL-LC-UNV-L8XX-CD1-U	7847	55	141.6
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-83SL-LC-UNV-L8XX-CD1-U	8537	61	139.6
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-90SL-LC-UNV-L8XX-CD1-U	9437	69	136.8
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-98SL-LC-UNV-L8XX-CD1-U	10101	75	134.4
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-105SL-LC-UNV-L8XX-CD1-U	10956	82	133.3
Clear Lens (LC)	High	8 ft.	8TSNLED-LD5-130HL-LC-UNV-L8XX-CD2-U	11786	86	136.7
Clear Lens (LC)	High	8 ft.	8TSNLED-LD5-170HL-LC-UNV-L8XX-CD2-U	15549	124	125.1

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Energy and Performance Data

Wattage: Round Semi-frost Lens, Narrow

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Semi-Frost Lens (LN)	Standard	2 ft.	2SNLED-LD5-18SL-LN-UNV-L8XX-CD1-U	1903	14	133.4
Semi-Frost Lens (LN)	Standard	2 ft.	2SNLED-LD5-22SL-LN-UNV-L8XX-CD1-U	2350	18	129.8
Semi-Frost Lens (LN)	Standard	2 ft.	2SNLED-LD5-26SL-LN-UNV-L8XX-CD1-U	2667	21	127.3
Semi-Frost Lens (LN)	High	2 ft.	2SNLED-LD5-32HL-LN-UNV-L8XX-CD1-U	3385	27	127.4
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-18SL-LN-UNV-L8XX-CD1-U	1835	13	140.8
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-22SL-LN-UNV-L8XX-CD1-U	2276	16	142.2
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-26SL-LN-UNV-L8XX-CD1-U	2620	18	142.0
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-30SL-LN-UNV-L8XX-CD1-U	2987	21	141.2
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-34SL-LN-UNV-L8XX-CD1-U	3463	25	139.2
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-37SL-LN-UNV-L8XX-CD1-U	3809	28	137.5
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-41SL-LN-UNV-L8XX-CD1-U	4144	31	135.6
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-46SL-LN-UNV-L8XX-CD1-U	4581	35	132.8
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-49SL-LN-UNV-L8XX-CD1-U	4903	38	130.4
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-53SL-LN-UNV-L8XX-CD1-U	5318	41	129.4
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-56SL-LN-UNV-L8XX-CD1-U	5708	46	123.7
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-61SL-LN-UNV-L8XX-CD1-U	6172	52	119.5
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-64SL-LN-UNV-L8XX-CD1-U	6435	55	116.7
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-50HL-LN-UNV-L8XX-CD1-U	5020	37	135.4
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-54HL-LN-UNV-L8XX-CD1-U	5252	39	134.5
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-60HL-LN-UNV-L8XX-CD1-U	5721	43	132.7
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-74HL-LN-UNV-L8XX-CD1-U	7548	62	121.5
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-60SL-LN-UNV-L8XX-CD1-U	5975	42	141.2
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-68SL-LN-UNV-L8XX-CD1-U	6926	50	139.2
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-75SL-LN-UNV-L8XX-CD1-U	7619	55	137.5
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-83SL-LN-UNV-L8XX-CD1-U	8289	61	135.6
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-91SL-LN-UNV-L8XX-CD1-U	9162	69	132.8
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-98SL-LN-UNV-L8XX-CD1-U	9807	75	130.4
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-106SL-LN-UNV-L8XX-CD1-U	10636	82	129.4
Semi-Frost Lens (LN)	High	8 ft.	8TSNLED-LD5-130HL-LN-UNV-L8XX-CD2-U	11442	86	132.7
Semi-Frost Lens (LN)	High	8 ft.	8TSNLED-LD5-170HL-LN-UNV-L8XX-CD2-U	15095	124	121.5

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Energy and Performance Data

Wattage: Round Full-frost Lens, Wide

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Full Frost Lens (LW)	Standard	2 ft.	2SNLED-LD5-16SL-LW-UNV-L8XX-CD1-U	1750	14	122.7
Full Frost Lens (LW)	Standard	2 ft.	2SNLED-LD5-20SL-LW-UNV-L8XX-CD1-U	2162	18	119.4
Full Frost Lens (LW)	Standard	2 ft.	2SNLED-LD5-23SL-LW-UNV-L8XX-CD1-U	2453	21	117.1
Full Frost Lens (LW)	High	2 ft.	2SNLED-LD5-30HL-LW-UNV-L8XX-CD1-U	2975	27	112.0
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-16SL-LW-UNV-L8XX-CD1-U	1688	13	129.5
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-20SL-LW-UNV-L8XX-CD1-U	2093	16	130.8
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-23SL-LW-UNV-L8XX-CD1-U	2410	18	130.7
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-27SL-LW-UNV-L8XX-CD1-U	2748	21	129.8
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-30SL-LW-UNV-L8XX-CD1-U	3186	25	128.0
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-33SL-LW-UNV-L8XX-CD1-U	3504	28	126.5
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-37SL-LW-UNV-L8XX-CD1-U	3812	31	124.7
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-41SL-LW-UNV-L8XX-CD1-U	4214	35	122.1
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-44SL-LW-UNV-L8XX-CD1-U	4511	38	120.0
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-47SL-LW-UNV-L8XX-CD1-U	4892	41	119.1
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-50SL-LW-UNV-L8XX-CD1-U	5251	46	113.8
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-56SL-LW-UNV-L8XX-CD1-U	5678	52	109.9
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-58SL-LW-UNV-L8XX-CD1-U	5920	55	107.3
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-44HL-LW-UNV-L8XX-CD1-U	4412	37	119.0
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-48HL-LW-UNV-L8XX-CD1-U	4615	39	118.2
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-54HL-LW-UNV-L8XX-CD1-U	5028	43	116.6
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-65HL-LW-UNV-L8XX-CD1-U	6633	62	106.7
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-54SL-LW-UNV-L8XX-CD1-U	5496	42	129.8
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-61SL-LW-UNV-L8XX-CD1-U	6371	50	128.0
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-67SL-LW-UNV-L8XX-CD1-U	6371	50	128.0
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-74SL-LW-UNV-L8XX-CD1-U	7625	61	124.7
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-81SL-LW-UNV-L8XX-CD1-U	8428	69	122.1
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-88SL-LW-UNV-L8XX-CD1-U	9022	75	120.0
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-95SL-LW-UNV-L8XX-CD1-U	9785	82	119.1
Full Frost Lens (LW)	High	8 ft.	8TSNLED-LD5-110HL-LW-UNV-L8XX-CD1-U	11356	103	109.9
Full Frost Lens (LW)	High	8 ft.	8TSNLED-LD5-150HL-LW-UNV-L8XX-CD2-U	15739	158	99.5

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Energy and Performance Data

Wattage: Square Flat Clear Lens

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Flat Clear Lens (SLC)	Standard	2 ft.	2SNLED-LD5-19SL-SLC-UNV-L8XX-CD1-U	1936	14	135.7
Flat Clear Lens (SLC)	Standard	2 ft.	2SNLED-LD5-24SL-SLC-UNV-L8XX-CD1-U	2391	18	132.1
Flat Clear Lens (SLC)	Standard	2 ft.	2SNLED-LD5-27SL-SLC-UNV-L8XX-CD1-U	2714	21	129.5
Flat Clear Lens (SLC)	High	2 ft.	2SNLED-LD5-37HL-SLC-UNV-L8XX-CD1-U	3669	27	138.1
Flat Clear Lens (SLC)	High	2 ft.	2SNLED-LD5-48HL-SLC-UNV-L8XX-CD1-U	4830	36	134.5
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-19SL-SLC-UNV-L8XX-CD1-U	1868	13	143.3
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-23SL-SLC-UNV-L8XX-CD1-U	2316	16	144.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-27SL-SLC-UNV-L8XX-CD1-U	2666	18	144.5
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-30SL-SLC-UNV-L8XX-CD1-U	3040	21	143.6
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-35SL-SLC-UNV-L8XX-CD1-U	3524	25	141.6
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-39SL-SLC-UNV-L8XX-CD1-U	3876	28	139.9
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-42SL-SLC-UNV-L8XX-CD1-U	4217	31	138.0
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-47SL-SLC-UNV-L8XX-CD1-U	4662	35	135.1
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-50SL-SLC-UNV-L8XX-CD1-U	4990	38	132.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-54SL-SLC-UNV-L8XX-CD1-U	5412	41	131.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-58SL-SLC-UNV-L8XX-CD1-U	5809	46	125.9
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-63SL-SLC-UNV-L8XX-CD1-U	6281	52	121.6
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-65SL-SLC-UNV-L8XX-CD1-U	6549	55	118.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-77SL-SLC-UNV-L8XX-CD1-U	7697	70	110.0
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-85SL-SLC-UNV-L8XX-CD1-U	8490	85	100.4
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-54HL-SLC-UNV-L8XX-CD1-U	5441	37	146.8
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-57HL-SLC-UNV-L8XX-CD1-U	5692	39	145.7
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-62HL-SLC-UNV-L8XX-CD1-U	6201	43	143.8
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-68HL-SLC-UNV-L8XX-CD1-U	6795	48	140.8
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-82HL-SLC-UNV-L8XX-CD1-U	8181	62	131.7
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-97HL-SLC-UNV-L8XX-CD1-U	9705	79	122.7
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-60SL-SLC-UNV-L8XX-CD1-U	6080	42	143.6
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-70SL-SLC-UNV-L8XX-CD1-U	7048	50	141.6
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-78SL-SLC-UNV-L8XX-CD1-U	7753	50	139.9
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-84SL-SLC-UNV-L8XX-CD1-U	8435	61	138.0
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-93SL-SLC-UNV-L8XX-CD1-U	9323	69	135.1
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-100SL-SLC-UNV-L8XX-CD1-U	9980	75	132.7
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-108SL-SLC-UNV-L8XX-CD1-U	10824	82	131.7
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-116SL-SLC-UNV-L8XX-CD1-U	11618	61	125.9
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-125SL-SLC-UNV-L8XX-CD2-U	12562	69	121.6
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-131SL-SLC-UNV-L8XX-CD2-U	13097	75	118.7
Flat Clear Lens (SLC)	High	8 ft.	8TSNLED-LD5-130HL-SLC-UNV-L8XX-CD2-U	12402	82	143.8
Flat Clear Lens (SLC)	High	8 ft.	8TSNLED-LD5-170HL-SLC-UNV-L8XX-CD2-U	16361	103	131.7
Flat Clear Lens (SLC)	High	8 ft.	8TSNLED-LD5-200HL-SLC-UNV-L8XX-CD2-U	19411	158	122.7

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Energy and Performance Data

Wattage: Square Flat Semi-frost Lens, Narrow

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Flat Semi-frost Lens (SLN)	Standard	2 ft.	2SNLED-LD5-19SL-SLN-UNV-L8XX-CD1-U	1931	14	135.3
Flat Semi-frost Lens (SLN)	Standard	2 ft.	2SNLED-LD5-24SL-SLN-UNV-L8XX-CD1-U	2385	18	131.7
Flat Semi-frost Lens (SLN)	Standard	2 ft.	2SNLED-LD5-27SL-SLN-UNV-L8XX-CD1-U	2706	21	129.1
Flat Semi-frost Lens (SLN)	High	2 ft.	2SNLED-LD5-37HL-SLN-UNV-L8XX-CD1-U	3659	27	137.7
Flat Semi-frost Lens (SLN)	High	2 ft.	2SNLED-LD5-48HL-SLN-UNV-L8XX-CD1-U	4816	36	134.2
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-19SL-SLN-UNV-L8XX-CD1-U	1863	13	142.9
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-23SL-SLN-UNV-L8XX-CD1-U	2309	16	144.3
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-27SL-SLN-UNV-L8XX-CD1-U	2659	18	144.1
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-30SL-SLN-UNV-L8XX-CD1-U	3032	21	143.2
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-35SL-SLN-UNV-L8XX-CD1-U	3514	25	141.2
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-39SL-SLN-UNV-L8XX-CD1-U	3866	28	139.5
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-42SL-SLN-UNV-L8XX-CD1-U	4206	31	137.6
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-46SL-SLN-UNV-L8XX-CD1-U	4649	35	134.7
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-50SL-SLN-UNV-L8XX-CD1-U	4976	38	132.4
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-54SL-SLN-UNV-L8XX-CD1-U	5397	41	131.4
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-58SL-SLN-UNV-L8XX-CD1-U	5793	46	125.6
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-63SL-SLN-UNV-L8XX-CD1-U	6264	52	121.3
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-65SL-SLN-UNV-L8XX-CD1-U	6530	55	118.4
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-78SL-SLN-UNV-L8XX-CD1-U	7676	70	109.7
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-85SL-SLN-UNV-L8XX-CD1-U	8466	85	100.1
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-54HL-SLN-UNV-L8XX-CD1-U	5426	37	146.4
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-57HL-SLN-UNV-L8XX-CD1-U	5676	39	145.3
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-62HL-SLN-UNV-L8XX-CD1-U	6184	43	143.4
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-68HL-SLN-UNV-L8XX-CD1-U	6776	48	140.5
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-82HL-SLN-UNV-L8XX-CD1-U	8158	62	131.3
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-97HL-SLN-UNV-L8XX-CD1-U	9679	79	122.4
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-64SL-SLN-UNV-L8XX-CD1-U	6063	42	143.2
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-70SL-SLN-UNV-L8XX-CD1-U	7028	50	141.2
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-77SL-SLN-UNV-L8XX-CD1-U	7731	55	139.5
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-84SL-SLN-UNV-L8XX-CD1-U	8411	61	137.6
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-93SL-SLN-UNV-L8XX-CD1-U	9297	69	134.7
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-100SL-SLN-UNV-L8XX-CD1-U	9952	75	132.4
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-108SL-SLN-UNV-L8XX-CD1-U	10794	82	131.4
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-116SL-SLN-UNV-L8XX-CD1-U	11586	92	125.6
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-125SL-SLN-UNV-L8XX-CD2-U	12527	103	121.3
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-130SL-SLN-UNV-L8XX-CD2-U	13061	110	118.4
Flat Semi-frost Lens (SLN)	High	8 ft.	8TSNLED-LD5-130HL-SLN-UNV-L8XX-CD2-U	12368	86	143.4
Flat Semi-frost Lens (SLN)	High	8 ft.	8TSNLED-LD5-170HL-SLN-UNV-L8XX-CD2-U	16316	124	131.3
Flat Semi-frost Lens (SLN)	High	8 ft.	8TSNLED-LD5-200HL-SLN-UNV-L8XX-CD2-U	19357	158	122.4

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Energy and Performance Data

Wattage: Square Flat Full-frost Lens, Wide

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Flat Full-frost Lens (SLW)	Standard	2 ft.	2SNLED-LD5-16SL-SLW-UNV-L8XX-CD1-U	1604	14	112.4
Flat Full-frost Lens (SLW)	Standard	2 ft.	2SNLED-LD5-20SL-SLW-UNV-L8XX-CD1-U	1981	18	109.4
Flat Full-frost Lens (SLW)	Standard	2 ft.	2SNLED-LD5-22SL-SLW-UNV-L8XX-CD1-U	2248	21	107.3
Flat Full-frost Lens (SLW)	High	2 ft.	2SNLED-LD5-30HL-SLW-UNV-L8XX-CD1-U	3077	27	115.8
Flat Full-frost Lens (SLW)	High	2 ft.	2SNLED-LD5-41HL-SLW-UNV-L8XX-CD1-U	4051	36	
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-15SL-SLW-UNV-L8XX-CD1-U	1547	13	118.7
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-19SL-SLW-UNV-L8XX-CD1-U	1918	16	119.8
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-22SL-SLW-UNV-L8XX-CD1-U	2209	18	119.7
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-25SL-SLW-UNV-L8XX-CD1-U	2518	21	119.0
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-29SL-SLW-UNV-L8XX-CD1-U	2919	25	117.3
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-32SL-SLW-UNV-L8XX-CD1-U	3211	28	115.9
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-35SL-SLW-UNV-L8XX-CD1-U	3494	31	114.3
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-39SL-SLW-UNV-L8XX-CD1-U	3862	35	111.9
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-41SL-SLW-UNV-L8XX-CD1-U	4134	38	110.0
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-45SL-SLW-UNV-L8XX-CD1-U	4483	41	109.1
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-48SL-SLW-UNV-L8XX-CD1-U	4812	46	104.3
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-52SL-SLW-UNV-L8XX-CD1-U	5203	52	100.7
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-54SL-SLW-UNV-L8XX-CD1-U	5425	55	98.4
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-64SL-SLW-UNV-L8XX-CD1-U	6376	70	91.1
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-70SL-SLW-UNV-L8XX-CD1-U	7033	48	83.1
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-46HL-SLW-UNV-L8XX-CD1-U	4564	37	123.1
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-48HL-SLW-UNV-L8XX-CD1-U	4774	39	122.2
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-52HL-SLW-UNV-L8XX-CD1-U	5201	43	120.6
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-57HL-SLW-UNV-L8XX-CD1-U	5699	48	118.1
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-69HL-SLW-UNV-L8XX-CD1-U	6862	62	110.4
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-81HL-SLW-UNV-L8XX-CD1-U	8141	79	102.9
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-50SL-SLW-UNV-L8XX-CD1-U	5037	42	119.0
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-58SL-SLW-UNV-L8XX-CD1-U	5838	50	117.3
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-64SL-SLW-UNV-L8XX-CD1-U	6422	55	115.9
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-70SL-SLW-UNV-L8XX-CD1-U	6987	61	114.3
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-77SL-SLW-UNV-L8XX-CD1-U	7723	69	111.9
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-83SL-SLW-UNV-L8XX-CD1-U	8267	75	110.0
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-90SL-SLW-UNV-L8XX-CD1-U	8966	82	109.1
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-96SL-SLW-UNV-L8XX-CD1-U	9624	92	104.3
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-104SL-SLW-UNV-L8XX-CD1-U	10406	103	100.7
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-108SL-SLW-UNV-L8XX-CD1-U	10850	110	98.4
Flat Full-frost Lens (SLW)	High	8 ft.	8TSNLED-LD5-130HL-SLW-UNV-L8XX-CD2-U	10402	86	120.6
Flat Full-frost Lens (SLW)	High	8 ft.	8TSNLED-LD5-170HL-SLW-UNV-L8XX-CD2-U	13723	124	110.4
Flat Full-frost Lens (SLW)	High	8 ft.	8TSNLED-LD5-200HL-SLW-UNV-L8XX-CD2-U	16281	158	102.9

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Cooper Lighting Solutions
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Peachtree City, GA 30269
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www.cooperlighting.com

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Specifications and dimensions
subject to change without notice.

TYPE L

Project		**Catalog #**		**Type**	
Prepared by		**Notes**		**Date**	

Downlight

Wall Wash

Portfolio

LD4C | EU4C | 4LB

4" Round, New Construction Downlight
Narrow, Medium, Wide Beam or Wall Wash
250-7500 Lumens

Typical Applications

Office • Education • Healthcare • Hospitality • Retail • Code-Compliance Areas • Sports Venues

Interactive Menu

- Order Information page 2
- Product Specifications page 4
- Energy Data page 6
- Photometric Data page 7
- Connected System page 14
- Product Warranty

Product Certification

ENERGY STAR · Efficiency Standards T24 · RoHS COMPLIANT · CERTIFIED · wet location · 2022 PROGRESS Report SELECTION

Control Compatibility

WaveLinx LITE · WaveLinx PRO

Product Features

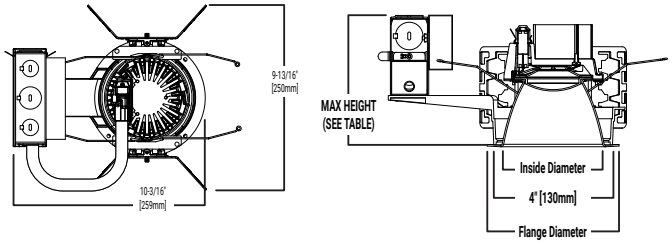
powered by fifthlight technology · Showerlight · PLENUM RESPONSE · COMPLIANT OPTION BAA BUY AMERICAN ACT AVAILABLE · COMPLIANT OPTION TAA TRADE AGREEMENTS ACT AVAILABLE

Top Product Features

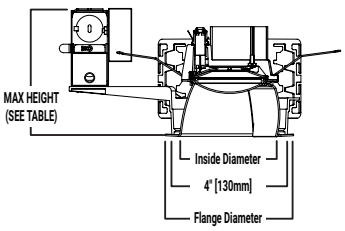
- 250-7500 lumens; Offered in 90 and 97 CRI; ENERGY STAR® qualified
- Easy disconnect for LED engine replacement and installation
- Optional snap in driver for ease of replacement
- Standard 0-10V driver dims to 1%
- 2400K, 2700K, 3000K, 3500K, 4000K, 5000K; D2W™ option from 3000K to 1850K
- Available W2N tunable white CCT range 2700K to 6500K or 2000K to 5000K
- Options to meet Buy American and other domestic preference requirements

Dimensional and Mounting Details

DOWNLIGHT



WALL WASH



DT4RF=4 inch frosted acrylic ring
See Accessories for Ordering

CLICK HERE dimension information

Single Line Order Information

Multi-line Ordering Information Option

SAMPLE ORDER NUMBER: **LD4C109030D010M1H**

Invoice will indicate separate fixture components (housing, trim, module) which will ship complete from a single CLS facility in separate cartons.
To receive separate components (housing, trim, module) shipment, click on the "Multi-Line Ordering Information Option" button to the right.

Housing	Lumen [1]				Color Control	CCT [20]	
LD4C=LED Downlight 4" Nominal Aperture **LD4CCP**=LED Downlight 4" Nominal Aperture, Chicago Plenum For BAA or TAA use Multi-line Ordering	**02** = 250 lumens, IC rated **05** = 500 lumens, IC rated **08** = 800 lumens, IC rated **10** = 1000 Lumens **10IC** = 1000 Lumens, IC rated	**15** = 1500 Lumens **15IC** = 1500 Lumens, IC rated **20** = 2000 Lumens **25** = 2500 lumens **30** = 3000 Lumens	**35** = 3500 lumens **40** = 4000 Lumens **45** = 4500 Lumens [10] **50** = 5000 Lumens [10] **55** = 5500 Lumens [10]	**60** = 6000 Lumens [10] **65** = 6500 Lumens [10] **70** = 7000 Lumens [10] **75** = 7500 Lumens [10]	**90**=90 CRI Minimum **97**=97 CRI Minimum	**90 CRI** **24**=2400K **27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K	**97 CRI** **27**=2700K **30**=3000K

Specify from Driver column. Information below for reference only.

Driver	Remote driver & plug in driver
D010=0-10V Dimming, 1% to 100%, 120V-277V up to 7000 lumens (up to 3000 lumens for remote driver) **1D010**=0-10V Dimming, 1% to 100%, 120V 7500 lumens (3500 to 7000 lumens for remote driver) **2D010**=0-10V Dimming, 1% to 100%, 277V 7500 lumens (3500 to 7000 lumens for remote driver) **3D010**=0-10V Dimming, 1% to 100%, 347V dedicated drivers for 800 to 4000 lumens; 250, 500, 4500 and above use step down transformer (250 to 7000 lumens for remote driver)	250-7000
D010TR=0-10V Dimming, 5% to 100%,120V-277V or 120V line voltage dimming 250- 4500 lumens (up to 3000 lumens for remote driver) **1D010TR**=0-10V or line voltage Dimming, 5% to 100%, 120V 5000-7500 lumens (3500 to 4500 lumens for remote driver) **2D010TR**=0-10V Dimming, 5% to 100%, 277V 5000-7500 lumens (3500 to 4500 lumens for remote driver) **3D010TR**=0-10V or line voltage Dimming, 5% to 100%, 347V step down transformer 250-7500 lumens (250 to 4500 lumens for remote driver)	250-4500
DE010=0-10V Dimming, 0% to 100%, 120V-277V 500-7000 lumens (up to 3000 lumens for remote driver) **1DE010**=0-10V Dimming, 0% to 100%, 120V 7500 lumens (3500 to 7000 lumens for remote driver) **2DE010**=0-10V Dimming, 0% to 100%, 277V 7500 lumens (3500 to 7000 lumens for remote driver) **3DE010**=0-10V Dimming, 0% to 100%, 347V step down transformer, 500-7500 lumens (500 to 7000 lumens for remote driver)	500-7000
D5LT=Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V-277V, 500-7000 lumens (up to 3000 lumens for remote driver) **1D5LT**=Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V 7500 lumens (3500 to 7000 lumens for remote driver) **2D5LT**=Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 277V 7500 lumens (3500 to 7000 lumens for remote driver) **3D5LT**=Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100% 347V step down transformer, 500-7500 lumens (500 to 7000 lumens for remote driver)	500-7000
DMX=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V 800-4500 lumens (up to 3000 lumens for remote driver) [14] **1DMX**= DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) [14] **2DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) [14] **3DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 800-7500 lumens (800 to 4500 lumens for remote driver) [14]	800-4500
DMXC5=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, 800-4500 lumens, RJ45 Connection (up to 3000 lumens for remote driver) [14] **1DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 5000-7500 lumens, RJ45 Connection (3500 to 4500 lumens for remote driver) [14] **2DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 5000-7500 lumens, RJ45 Connection (3500 to 4500 lumens for remote driver) [14] **3DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 800-7500 lumens, RJ45 Connection (800 to 4500 lumens for remote driver) [14]	800-4500
1DL2 = Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 120V Only 800-7500 lumens (800 to 3500 lumens for remote driver) **3DL2** = Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 347V step down transformer, 800-7500 lumens (800 to 3500 lumens for remote driver)	800-3500
DLE=Lutron Ecosystem dimming 1% to 100%, 120V-277V, 800-3500 lumens (up to 3000 lumens for remote driver) **1DLE**=Lutron Ecosystem dimming 1% to 100%, 120V, 4000-7500 lumens (3500 lumens for remote driver) **2DLE**=Lutron Ecosystem dimming 1% to 100%, 277V, 4000-7500 lumens (3500 lumens for remote driver) **3DLE**=Lutron Ecosystem dimming 1% to 100%, 347, step down transformer, 800-7500 lumens (800-3500 lumens for remote driver)	800-3500
DLV = Low voltage dimming driver (1-100%) for use with DLVP system 800-3000 lumens [3]	800-3000 (Remote driver only)

Driver Options		Hanger Bars
Blank = Integral driver **RC100** = Remote 100ft [3] [33] **RC75** = Remote 75ft [3] [33] **RC50** = Remote 50ft [3] [33] **RC25** = Remote 25ft [3]	**RC15** = Remote 15ft [3] **RC5** = Remote 5ft [3] **RC2** = Remote 2ft [3] **PD** = Plug in Driver	**Blank** = Without hanger bars **B26** = C-channel Bar Hanger, 26" Long, Pair

Trim Distribution [5]	Trim Flange	Trim Finish	Options [3] [16] [31]
N=Narrow, Spun Aluminum [26] **M**=50° Cutoff, Medium Beam Reflector, Spun Aluminum **MD**=45° Cutoff, Medium Beam Reflector, Spun Aluminum **W**=Wide, Spun Aluminum **S**=Shallow, Spun Aluminum **HY**=Hyperbolic medium beam [12] **PS**=Non-Conductive Shallow, Injection Molded white [11] [12] **CS**=Cast Shallow, Die Cast Aluminum **BA**= Spun Aluminum Baffle [7] **Wall Wash** **SWN** = Single Wall Wash, Spun Aluminum **DWN** = Double Wall Wash, Spun Aluminum **CW** = Corner Wall Wash, Spun Aluminum **LSWW** = Lensed Single wall wash, Spun Aluminum **LDWW** = Lensed Double wall wash, Spun Aluminum	**0**=White Polymer Trim Ring **1**=Self-flanged [13] **2**=White Painted Self-flanged **4**=Knife edge rimless use with die cast only [8] [23]	**LI**=Specular Clear [9] **H**=Semi-Specular Clear [9] **WMH**=Warm Haze [9] **WH**=Wheat [9] **GPH**=Graphite Haze [9] **B**=Specular Black [9] **MW**=Matte White (Antimicrobial) **MB**=Matte Black [8] **MMS**=Matte Metallic Silver [8]	**EMBOD**=Bodine® Emergency Module with Remote Test Switch [25] **EMBOD6ST**=Bodine® 6W Self Test Emergency Module with Remote Test Switch **EM7**=7W Emergency Module with Remote Test Switch **EM14**=14W Emergency Module with Remote Test Switch **EMBOD7ST**=Bodine® Self Test Emergency Module [25] **IEMBOD**=Bodine® Emergency Module with Integral Test Switch [6] [25] **IEM7**=7W Emergency Module with Integral Test Switch [6] **IEM14**=14W Emergency Module with Integral Test Switch [6] **EMV7**=7W Low Voltage Emergency Module with Remote Test Switch [4] **EMV14**=14W Low Voltage Emergency Module with Remote Test Switch [4] **ETRD**=Emergency transfer device [32] **WPST** = Factory installed Wavelinx (includes control module, sensor, cable, tilemount and ceiling mount sensor) [15] [18] **WLST** = Factory installed WaveLinx LITE Sensor Kit [15] [17] **WPN** = WaveLinx PRO Wireless Node without sensor [20]

Continued on next page.

Single Line Order Information

Accessories (*Sold separately*) [22]

TRM4P=White metal trim ring [2]
LGSKT4IP66=IP66 Gasket Kit
DT4RF=6 inch frosted acrylic ring [29]

PRR4=Rimless Plaster Ring [2]
RKP4=Knife Edge plaster Ring [24]

RPM4MW=Rimless Millwork Ring, Matte White [2]
RPM4MB=Rimless Millwork Ring, Matte Black [2]
RKM4MW=Knife Edge Millwork Ring, Matte White [24]
RKM4MB=Knife Edge Millwork Ring, Matte Black [24]

HSA4=Slope Adapter for 4" Aperture Housings, Specify Slope [34]

Connected Lighting Systems [3] [15]
WPST = Field installed WaveLinx sensor Kit [17]
WLST = Field installed WaveLinx LITE Sensor Kit [18]

Transformers
H347=H347 for 5500 lumens and below
H347200=347 to 120V Step Down Transformer, 200VA

Bar Hangers
HB50=C-channel Bar Hanger, 50" Long, Pair
RMB22=Wood Joist Bar Hanger, 22" Long, Pair

Notes:
1. Nominal Lumens will vary depending on selected color, CRI, driver and reflector finish. Reference Multiplier tables.
2. Order trim with polymer trim ring (Consult specification sheet for color ordering information and options).
3. Not available with Chicago Plenum.
4. ULus listed only
5. Beam angles are nominal with LI finish trims.
6. Available with narrow (N), medium (M) and medium 45 degree (MD) Spun Aluminum trims. Required for use with all, IEMBOD, IEM7, IEM14,IEMV7 and IEMV14 housings. Not offered with remote driver.
7. Only available with Matte White and Matte Black Finishes.
8. Available only on CS distributions.
9. Not available on PS, CS or BA distributions.
10. Product is marked spacing. Reference table on page 4.
11. PS available in self-flanged MW finish only.
12. Offered up to 2000 lumens
13. Flange is the same finish as the reflector
14. DMX fixtures default to full on upon loss of DMX signal.
15. Refer to system specifications for additional information,features, and benefits. Order either factory installed option or accessory. Use with 0-10V driver.
16. Non-IC
17. WLST = WaveLinx LITE tilemount sensor kit for daylight dimming, PIR motion sensing, use with D010 only (Refer to WaveLinx LITE system specifications)
18. WPST = WaveLinx wireless sensor kit for daylight dimming, PIR motion sensing, and optional RLTS - Real Time Location Services, use with 0-10V only.
20. WPN = WaveLinx PRO wireless node provides luminaire-level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with 0-10V driver only.
22. Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information.
23. Accessory (Requires knife edge accessory ring)
24. Order die cast trim with flange type 4
25. Not available with 6500-7000 lumens, DLVP up to 3000 lumens
26. Offered with
- D010, D5LT, DE010 up to 7000 lumens
- D010TR, DMX up to 4500 lumens
- DLE, DL2 up to 3500 lumens
29. Order with self flanged trim.
31. 120V-277V
32. Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others)
33. Not available with Lutron drivers
34. Not recommended for use with Wall Wash

Product Specifications

Lower Shielding Reflector
- Painted die-cast aluminum or spun aluminum lower reflector with lensed upper optical chamber provides superior lumen output with minimal source brightness
- Spun reflectors are available in all Portfolio anodized finishes
- Hyperbolic reflector provides minimal aperture brightness and glare.
- Available with non-conductive polymer reflector up to 2000 lumens
- Plaster lathing ring, knife edge and millwork ring accessory for flush reflector transition
- Decorative frosted acrylic ring provides a light glow in the ceiling

Wall Wash Reflector
- **Open Wall Wash** - wall wash reflector with gradient kicker offered in single, double and corner wall wash provides even vertical illumination with minimal source brightness.
- **Rotatable Lensed Wall Wash** - Rotatable Lensed wall wash reflector offered in single and double wall wash provides even vertical illumination with minimal source brightness.

Trim Retention
- Two torsion springs hold reflector flange tightly to the finished ceiling surface

Plaster Frame/Collar
- Die-cast aluminum 1 ½" deep collar
- Accommodates up to 2" ceiling thickness

Universal Mounting Bracket
- Accepts 1/2" Electric Metallic Tube (EMT), C-channel and bar hangers
- Adjusts 5" vertically from above and below the ceiling

Junction box
- Four 1/2" and two 3/4" trade size pry outs positioned to allow straight conduit runs
- Lever connectors for simple push in wiring
- Listed for eight #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring

Thermal
- Aluminum heat sink conducts heat away from the LED module for improved performance and longer life

LED System
- Contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution without pixilation
- Auto resetting, thermally protected, LED's are turned off when safe operating temperatures are exceeded
- Quick disconnect allows for tool-less replacement of LED engine from below ceiling
- 90 and 97 CRI
- 90 & 97CRI: L78 55,000 hours for 1000-2000 lumens, L90 55,000 for all other lumen output
- Color variation within 2-step MacAdam ellipses
- Available in 2400K, 2700K, 3000K, 3500K, 4000K and 5000K correlated color temperature (CCT)

Vividtune and High CRI
- 98 CRI and W2N: L70 55,000 hours
- D2W™ – dim-to-warm shifts CCT from 3000K to 1850K as fixture dims mimicking halogen sources.
- W2N - Tunable white CCT range 2700K to 6500K or 2000K to 5000K, 90 CRI. Standard
- **98 CRI** With a full-spectrum approach using broad-blue chip technology and special phosphor blends, Thrive is able to closely match the spectrum of the sun across all color temperatures. Benefits of the natural spectrum of the sun using Thrive include superior accurate color rendering, reduced eye strain, and a higher sense of emotional well-being.
- See dedicated specification sheet for more details.

Driver
- Standard 120-277V 0-10V dimming driver provides flicker free dimming from 100% to 1%
- Optional 120V leading edge/0-10V, <1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem
- Driver can be serviced from above or through the aperture
- Distributed low voltage power system combines power, lighting, and controls with ease of installation.
- Optional magnetically guided snap in driver for ease of maintenance.

Emergency Option
- Provides 90 minutes of standby lighting, meeting most life safety codes for egress lighting
- Available with integral or remote charge indicator and test switch
- Available Self-Test with remote charge indicator and test switch
- Emergency transfer device (ETRD) senses the loss of power regardless of local control settings allowing emergency power to the fixture.
- UL 924 listed

Connected Lighting System
Two WaveLinx connected solutions to choose from. Refer to WaveLinx system specifications and application guides for details.

WaveLinx PRO Tilemount Sensor Kit
- WaveLinx WPST tilemount sensor kit offers daylight dimming, PIR motion sensing, scene and zone configuration, automatic commissioning; and optional RLTS - Real Time Location Services available.

WaveLinx PRO Wireless Node
- WaveLinx PRO wireless node provides luminaire-level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with 0-10V driver only.

WaveLinx LITE Tilemount Sensor Kit
- WaveLinx LITE WLST tilemount sensor kit offers daylight dimming and PIR motion sensing, scene and grouping configuration.

WaveLinx Tilemount Kits Application
- The WPST and WLST tilemount kits include a control module mounted on the luminaire junction box via 1/2" knock-out, and a tilemount sensor on 54-inch whip; for ceiling installation by direct-mount spring clips or via mounting bracket in octagon ceiling boxes.
- The WPST and WLST tilemount kits may be ordered as factory installed on the luminaire, or ordered separately as a field installed accessory kit.

Code Compliance
- Thermally protected
- cULus Certified to UL 1598 / C22.2 No. 250.0 suitable for wet locations with downlight; damp location with wall wash and hyperbolic with covered ceiling
- IP66 rated when used with IP66 gasket kit accessory
- Optional City of Chicago environmental air (CCEA) marking for plenum applications
- FCC CFR Title 47 Part 15 Class B at 120VAC and Class A at 277VAC
- Insulated ceiling (IC) rated up to 1,500 lumens (90 and 97CRI). All others are non-IC rated (insulation must be kept 3" from top and sides of housing).
- Can be used for State of California Title 24 high efficacy LED compliance under JA8, reference Modernized Appliance Efficiency Database System (MAEDBS) for 2016 JA8 High Efficacy Lighting
- RoHS compliant
- Photometric testing completed in accordance with IES LM-79
- LED life testing completed in accordance with IES LM-80-08 and TM-21-11 standards
- See table on page 3 for marked spacing requirements

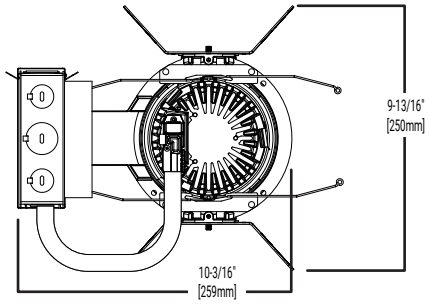
Warranty
- Five year warranty www.cooperlighting.com/legal

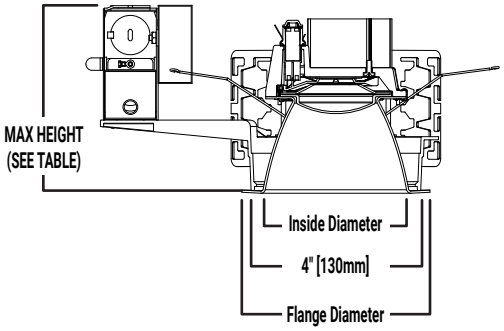
Marked Spacing

4-inch Marked spacing for 90 and 97 CRI			
4000	36	36	0.5
4000-7500 (Lutron)	36	36	8
4500-7500	36	36	8

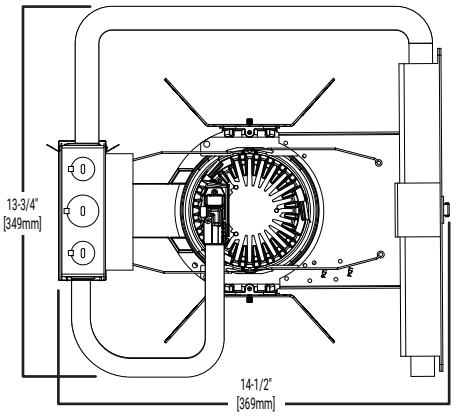
Dimensional and Mounting Details

DOWNLIGHT

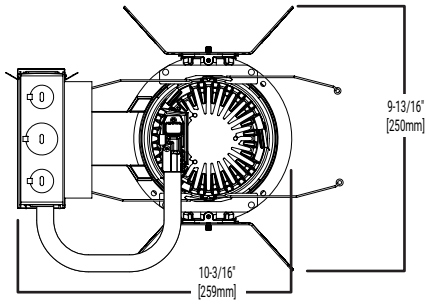


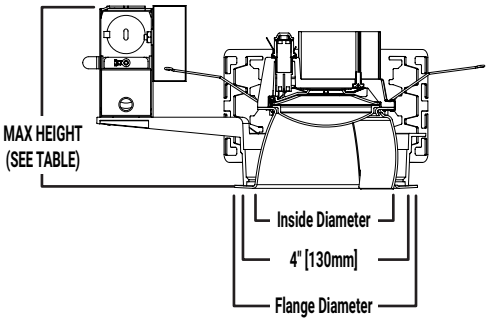


EM OPTION



WALL WASH





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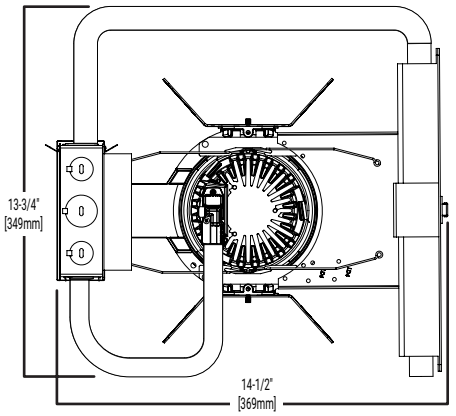
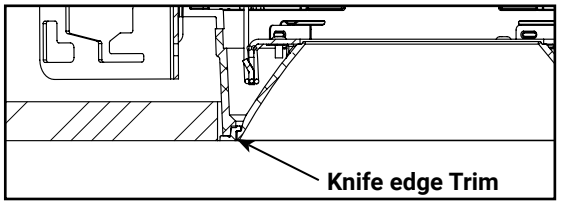
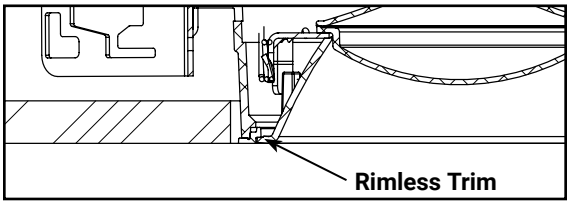






CATALOG #	Flange DIAMETER or WIDTH [IN]	INSIDE DIAMETER or WIDTH [IN]	MAX HEIGHT				
			250-2000 LUMENS (90/97CRI)	2500-4000 LUMENS (90/97CRI)	4500-6000 LUMENS (90/97CRI)	1000-1500IC LUMENS (90/97CRI) 6500-7000 LUMENS (90/97CRI)	2 LEDs 4500-7500 LUMENS (90/97CRI)
4LBN	5.67	4.24	5.6	5.6	5.6	6.1	8.1
4LBM	5.67	4.26	5.6	5.6	5.6	6.1	8.1
4LBW	5.67	4.27	5.6	5.6	5.6	5.7	7.7
4LBBA	5.67	4.28	5.6	5.6	5.6	6.1	8.1
4LBMD	5.67	4.26	5.8	5.9	6.4	6.9	8.9
4LBHY	5.67	4.34	5.6	5.6	5.6	6.1	8.1
4LBS	5.67	4.23	5.6	5.6	5.6	5.6	6.4
4LBPS	5.67	4.23	5.6	5.6	5.6	5.6	6.5
4LBCS	5.67	4.23	5.6	5.6	5.6	5.6	6.5
4LBSWN	5.67	4.27	5.6	5.6	5.6	5.7	7.7
4LBDWN	5.67	4.27	5.6	5.6	5.6	5.7	7.7
4LBCW	5.67	4.01	5.6	5.6	5.6	5.7	7.7
4LBLSWW	5.67	4.27	5.6	5.6	5.6	5.7	7.7
4LBLDWW	5.67	4.27	5.6	5.6	5.6	5.7	7.7

Energy and Performance Data

D010 DRIVER ENERGY DATA

Series	250 lumen		500 lumen		800 lumen		1000 lumen		1500 lumen		2000 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V
Input Current (A)	0.029	0.017	0.061	0.032	0.085	0.041	0.084	0.042	0.135	0.063	0.189	0.084
Input Power (W)	3.45	3.87	7.33	7.78	10.15	10.52	10.04	10.43	16.17	16.56	22.58	22.63
In-rush (A)	2.1	8.5	3.7	8.5	3.6	8.3	3.6	8.4	2.3	9.5	2.1	9.7
Inrush duration (µs)	250	131	190	136	220	135	226	136	230	125	243	132
THDi (%)	7.21	16.92	7.82	10.78	5.57	9.63	7.78	9.24	4.75	9.93	8.03	7.44
PF	≥ 0.98	≥ 0.9	≥ 0.99	≥ 0.93	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.94	≥ 0.99	≥ 0.96

Series	2500 lumen		3000 lumen		3500 lumen		4000 lumen		4500 lumen		5000 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V
Input Current (A)	0.276	0.121	0.276	0.121	0.333	0.152	0.404	0.181	0.421	0.192	0.491	0.216
Input Power (W)	32.98	32.57	32	32.57	39.83	39.84	48.38	47.94	50.22	50.17	58.69	58.01
In-rush (A)	2.5	11.8	3.6	11.8	3.1	14.3	3.1	14.5	5.6	22.6	5.6	22.6
Inrush duration (µs)	215	111	220	111	200	94	197	95	215	120	213	135
THDi (%)	9.86	6.57	5.57	6.57	4.25	10.05	5.02	7.97	6.12	8.35	8.51	7.92
PF	≥ 0.99	≥ 0.97	≥ 0.99	≥ 0.99	≥ 0.99	≥ 0.94	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.96

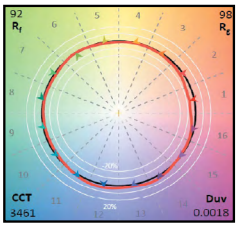
Series	5500 lumen		6000 lumen		6500 lumen		7000 lumen		7500 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V
Input Current (A)	0.526	0.231	0.542	0.256	0.572	0.266	0.632	0.292	0.668	0.306
Input Power (W)	62.97	61.97	64.88	65.7	68.35	69.02	75.56	75.85	79.89	80.09
In-rush (A)	5.1	23.1	6.2	27.5	6.3	28.4	6.4	29.1	6.4	28.7
Inrush duration (µs)	217	138	188	101	189	92	187	90	185	100
THDi (%)	9.42	7.16	4.33	11.86	4.38	11.33	4.84	10.32	4.46	9.85
PF	≥ 0.99	≥ 0.96	≥ 0.99	≥ 0.93	≥ 0.99	≥ 0.93	≥ 0.99	≥ 0.94	≥ 0.99	≥ 0.94

Minimum starting temperature -30°C (-22°F)* (Nominal input 120-277VAC & 100% of rated output power)
Sound Rating: Class A standards

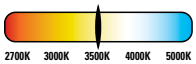
Notes:
Emergency Battery packs are rated for a minimum starting temperature of 0°C.

COLOR METRICS - TM-30-15 & CRI/CIE

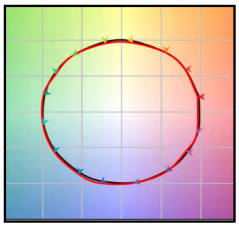
90 CRI Color Metric Summary - 3500K*



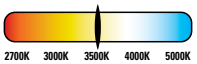
TM-30-15	Rf = 92
	Rg = 98
CRI/CIE	Ra = 92.2
	R9 = 51.4



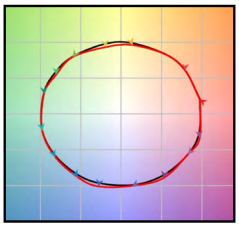
97 CRI Color Metric Summary - 2700K*



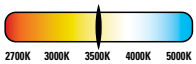
TM-30-15	Rf = 95
	Rg = 99.8
CRI/CIE	Ra = 92.2
	R9 = 85.8



97 CRI Color Metric Summary - 3000K*



TM-30-15	Rf = 93.9
	Rg = 100.2
CRI/CIE	Ra = 92.2
	R9 = 98.7



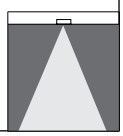
* Color values are based on haze reflector, other finishes and field results may vary.

Photometric Data

View IES files

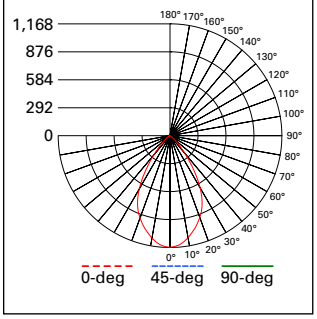
MEDIUM BEAM 50° CUTOFF 65° BEAM (H)

Test Number	P571636
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBMH
Lumens	1178
Efficacy	74.6 Lm/W
SC	0.95
UGR	11.9

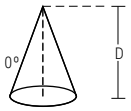


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	73	3.6	3.6
7'	23.8	6.6	6.6
9'	14.4	8.4	8.4
13'	6.9	12.2	12.2
16'	4.6	15	15

CANDELA TABLE

Degrees Vertical	Candela
0	1168
5	1147
15	1006
25	800
35	437
45	135
55	32
65	9
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

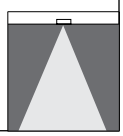
Zone	Lumens	% Fixture
0-30	752	63.8
0-40	1024	87
0-60	1165	98.9
0-90	1178	100
90-180	0	0
0-180	1178	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	55459
45	23472
55	6854
65	2587
75	854
85	0

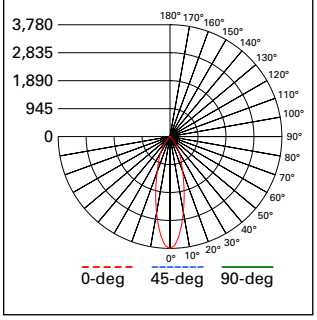
MEDIUM BEAM 50° CUTOFF 45° BEAM (LI)

Test Number	P571637
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBMLI
Lumens	1469
Efficacy	93 Lm/W
SC	0.48
UGR	0



CANDLEPOWER DISTRIBUTION

Downlight



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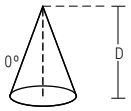


D	FC	L	W
4'	236.3	1.8	1.8
7'	77.2	3.2	3.2
9'	46.7	4.2	4.2
13'	22.4	6.2	6.2
16'	14.8	7.6	7.6

CANDELA TABLE

Degrees Vertical	Candela
0	3780
5	3389
15	1844
25	873
35	339
45	38
55	2
65	2
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

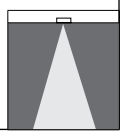
Zone	Lumens	% Fixture
0-30	1213	82.6
0-40	1428	97.2
0-60	1468	99.9
0-90	1469	100
90-180	0	0
0-180	1469	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	38008
45	6672
55	493
65	669
75	0
85	0

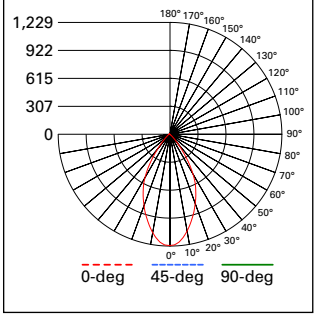
NARROW 55° BEAM (H)

Test Number	P571638
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBNH
Lumens	979
Efficacy	62 Lm/W
SC	0.81
UGR	8.2

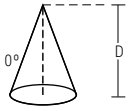


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	76.8	3.2	3.2
7'	25.1	5.6	5.6
9'	15.2	7.2	7.2
13'	7.3	10.4	10.4
16'	4.8	12.8	12.8

CANDELA TABLE

Degrees Vertical	Candela
0	1229
5	1197
15	963
25	685
35	332
45	67
55	16
65	5
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

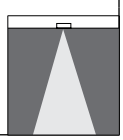
Zone	Lumens	% Fixture
0-30	692	70.7
0-40	899	91.8
0-60	972	99.2
0-90	979	100
90-180	0	0
0-180	979	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	39457
45	11710
55	3406
65	1541
75	854
85	0

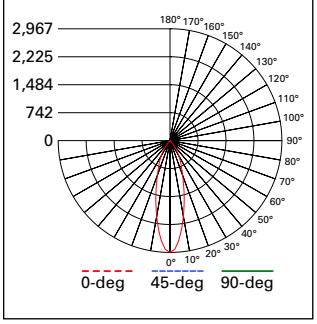
NARROW 30° BEAM (LI)

Test Number	P571639
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBNLI
Lumens	1153
Efficacy	73 Lm/W
SC	0.48
UGR	0

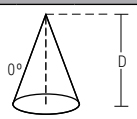


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	185.4	1.8	1.8
7'	60.6	3.2	3.2
9'	36.6	4.2	4.2
13'	17.6	6.2	6.2
16'	11.6	7.6	7.6

CANDELA TABLE

Degrees Vertical	Candela
0	2967
5	2660
15	1447
25	685
35	266
45	30
55	2
65	2
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	952	82.6
0-40	1121	97.2
0-60	1152	99.9
0-90	1153	100
90-180	0	0
0-180	1153	100

LUMINANCE

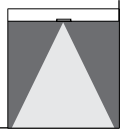
Average Candela Degrees	Average 0° Luminance
37	29831
45	5247
55	386
65	523
75	0
85	0

Photometric Data

View IES files

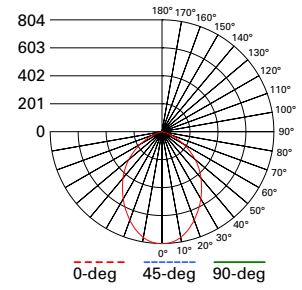
SHALLOW 85° BEAM (H)

Test Number	P571640
Housing	LD4C15D010
Module	EU4B10209035
Trim	4LBSH
Lumens	1538
Efficacy	97.3 Lm/W
SC	1.06
UGR	26.5

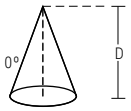


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	50.3	4.2	4.2
7'	16.4	7.4	7.4
9'	9.9	9.4	9.4
13'	4.8	13.6	13.6
16'	3.1	16.8	16.8

CANDELA TABLE

Degrees Vertical	Candela
0	804
5	798
15	730
25	618
35	496
45	376
55	246
65	120
75	29
85	0
90	0

ZONAL LUMEN SUMMARY

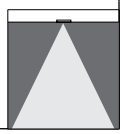
Zone	Lumens	% Fixture
0-30	565	36.7
0-40	875	56.9
0-60	1384	90
0-90	1538	100
90-180	0	0
0-180	1538	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	72577
45	65309
55	52605
65	34942
75	13670
85	0

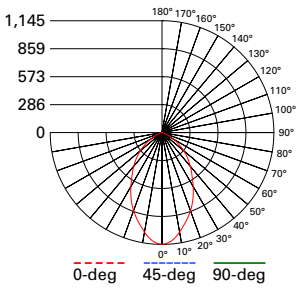
SHALLOW 65° BEAM (LI)

Test Number	P571641
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBSLI
Lumens	1604
Efficacy	101.5 Lm/W
SC	0.91
UGR	23.9



CANDLEPOWER DISTRIBUTION

Downlight



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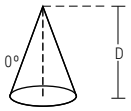


D	FC	L	W
4'	71.6	3.6	3.6
7'	23.4	6.2	6.2
9'	14.1	8.2	8.2
13'	6.8	11.8	11.8
16'	4.5	14.4	14.4

CANDELA TABLE

Degrees Vertical	Candela
0	1145
5	1115
15	945
25	749
35	534
45	371
55	208
65	73
75	4
85	0
90	0

ZONAL LUMEN SUMMARY

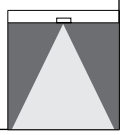
Zone	Lumens	% Fixture
0-30	712	44.4
0-40	1048	65.3
0-60	1520	94.8
0-90	1604	100
90-180	0	0
0-180	1604	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	77201
45	64475
55	44508
65	21163
75	1709
85	0

WIDE 80° BEAM (H)

Test Number	P571642
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBWH
Lumens	1309
Efficacy	82.8 Lm/W
SC	1.18
UGR	17.9



CANDLEPOWER DISTRIBUTION

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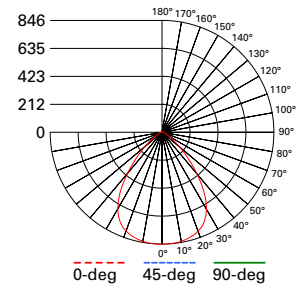

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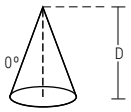


D	FC	L	W
4'	52.7	4.6	4.6
7'	17.2	8.2	8.2
9'	10.4	10.4	10.4
13'	5	15.2	15.2
16'	3.3	18.8	18.8

CANDELA TABLE

Degrees Vertical	Candela
0	844
5	844
15	821
25	748
35	547
45	265
55	84
65	23
75	7
85	0
90	0

ZONAL LUMEN SUMMARY

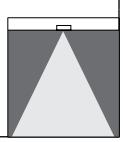
Zone	Lumens	% Fixture
0-30	653	49.9
0-40	991	75.7
0-60	1276	97.5
0-90	1309	100
90-180	0	0
0-180	1309	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	75186
45	45989
55	17885
65	6715
75	3370
85	0

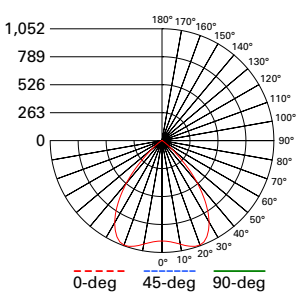
WIDE 80° BEAM (LI)

Test Number	P571643
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBWLI
Lumens	1551
Efficacy	98.2 Lm/W
SC	1.29
UGR	6.9

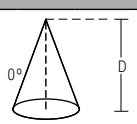


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	59.5	5	5
7'	19.4	9	9
9'	11.8	11.6	11.6
13'	5.6	16.6	16.6
16'	3.7	20.6	20.6

CANDELA TABLE

Degrees Vertical	Candela
0	950
5	963
15	1036
25	1005
35	723
45	279
55	28
65	4
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	844	54.4
0-40	1289	83.1
0-60	1546	99.7
0-90	1551	100
90-180	0	0
0-180	1551	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	-
45	-
55	-
65	-
75	-
85	-

Photometric Data

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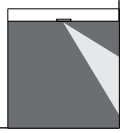
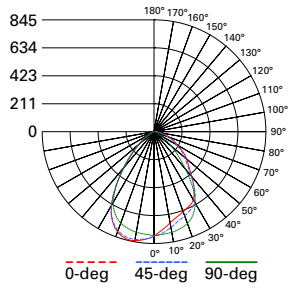
SINGLE WALL WASH (H)

Test Number	P571644
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LCSWH
Lumens	1390
Efficacy	88 Lm/W
SC	1.17
UGR	29.6



CANDLEPOWER DISTRIBUTION

Downlight



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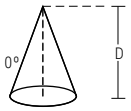


D	FC	L	W
4'	51	4.4	4.6
7'	16.6	7.9	8
9'	10.1	10.1	10.2
13'	4.8	14.7	15
16'	3.2	18.1	18.4

CANDELA TABLE

Degrees Vertical	Candela
0	793
5	746
15	669
25	625
35	527
45	371
55	262
65	159
75	74
85	17
90	0

ZONAL LUMEN SUMMARY

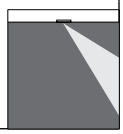
Zone	Lumens	% Fixture
0-30	608	43.8
0-40	928	66.7
0-60	1283	92.3
0-90	1390	100
90-180	0	0
0-180	1390	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	75835
45	64441
55	56032
65	46337
75	34936
85	24527

SINGLE WALL WASH (LI)

Test Number	P571645
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LCSWLI
Lumens	1445
Efficacy	91.5 Lm/W
SC	1.3
UGR	28.3



CANDLEPOWER DISTRIBUTION

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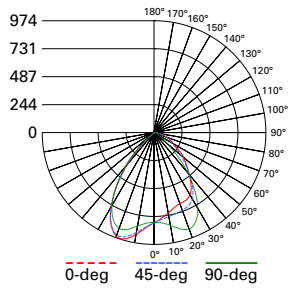

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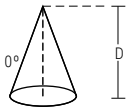


D	FC	L	W
4'	54.2	4.5	4.8
7'	17.7	8	8.6
9'	10.7	10.3	11
13'	5.1	14.9	16
16'	3.4	18.4	19.6

CANDELA TABLE

Degrees Vertical	Candela
0	783
5	745
15	673
25	648
35	548
45	384
55	235
65	143
75	57
85	10
90	0

ZONAL LUMEN SUMMARY

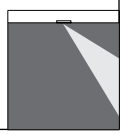
Zone	Lumens	% Fixture
0-30	680	47.1
0-40	1041	72.1
0-60	1362	94.2
0-90	1445	100
90-180	0	0
0-180	1445	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	78745
45	66786
55	50356
65	41599
75	27151
85	14378

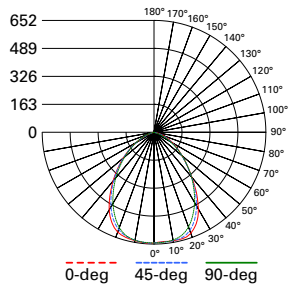
LENSED WALL WASH (LI)

Test Number	P571646
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBLWWLI
Lumens	1246
Efficacy	78.9 Lm/W
SC	1.12
UGR	26.3

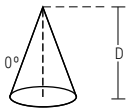


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	40.7	4.6	4.4
7'	13.3	8.2	7.8
9'	8	10.6	10
13'	3.8	15.4	14.4
16'	2.5	19	17.8

CANDELA TABLE

Degrees Vertical	Candela
0	650
5	644
15	647
25	591
35	439
45	278
55	174
65	99
75	42
85	3
90	0

ZONAL LUMEN SUMMARY

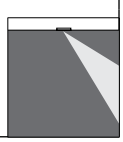
Zone	Lumens	% Fixture
0-30	499	40
0-40	766	61.5
0-60	1139	91.4
0-90	1246	100
90-180	0	0
0-180	1246	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	61806
45	48248
55	37226
65	28866
75	19936
85	4088

LENSED WALL WASH (H)

Test Number	P571647
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBLWWH
Lumens	1196
Efficacy	75.7 Lm/W
SC	1.09
UGR	26.5



CANDLEPOWER DISTRIBUTION

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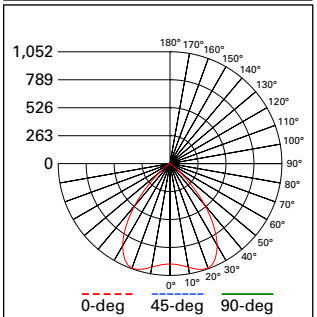

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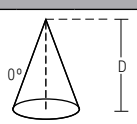

D	FC	L	W
4'	39.7	4.5	4.2
7'	13	8	7.6
9'	7.8	10.2	9.8
13'	3.8	14.8	14
16'	2.5	18.3	17.4

CANDELA TABLE

Degrees Vertical	Candela
0	635
5	639
15	639
25	586
35	441
45	280
55	174
65	100
75	43
85	4
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	471	39.4
0-40	724	60.5
0-60	1084	90.6
0-90	1196	100
90-180	0	0
0-180	1196	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	62135
45	48734
55	37269
65	29099
75	20268
85	5497

Photometric Data

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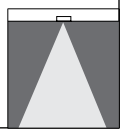
MEDIUM BEAM 45° CUTOFF 55° BEAM (H)

Test Number	P571648
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBMDH
Lumens	1113
Efficacy	70.4 Lm/W
SC	0.86
UGR	9.5



CANDLEPOWER DISTRIBUTION

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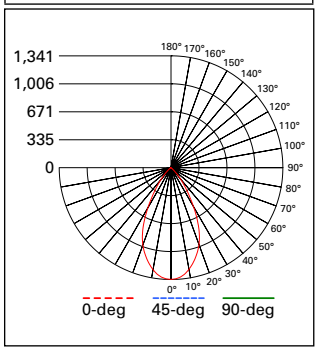

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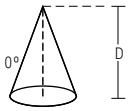


D	FC	L	W
4'	83.8	3.4	3.4
7'	27.4	6	6
9'	16.6	7.6	7.6
13'	7.9	11	11
16'	5.2	13.6	13.6

CANDELA TABLE

Degrees Vertical	Candela
0	1341
5	1318
15	1127
25	791
35	337
45	91
55	20
65	7
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

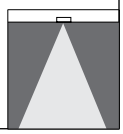
Zone	Lumens	% Fixture
0-30	793	71.3
0-40	1008	90.6
0-60	1103	99.1
0-90	1113	100
90-180	0	0
0-180	1113	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	41780
45	15758
55	4284
65	2064
75	1044
85	423

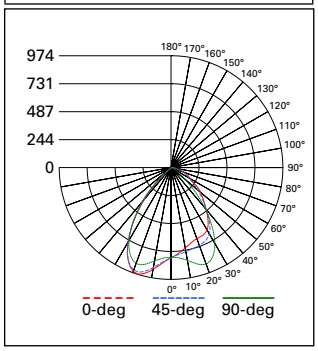
MEDIUM BEAM 45° CUTOFF 50° BEAM (LI)

Test Number	P571649
Housing	LD4C15D010
Module	EU4C10209035
Trim	4LBMDLI
Lumens	1294
Efficacy	81.9 Lm/W
SC	0.84
UGR	0.4

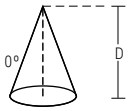


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	108.2	3.2	3.2
7'	35.3	5.6	5.6
9'	21.4	7.4	7.4
13'	10.2	10.6	10.6
16'	6.8	13.2	13.2

CANDELA TABLE

Degrees Vertical	Candela
0	1700
5	1751
15	1545
25	945
35	323
45	47
55	6
65	2
75	1
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	1023	79.1
0-40	1243	96
0-60	1291	99.8
0-90	1294	100
90-180	0	0
0-180	1294	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	36556
45	8096
55	1199
65	640
75	285
85	0

Photometric Multipliers (Nominal Lumen Values)

250 Lumen	500 Lumen	800 Lumen	1000 Lumen	1500 Lumen	2000 Lumen	2500 Lumen	3000 Lumen	3500 Lumen
0.22	0.42	0.57	0.65	1.00	1.29	1.62	1.90	2.25

4000 Lumen	4500 Lumen	5000 Lumen	5500 Lumen	6000 Lumen	6500 Lumen	7000 Lumen	7500 Lumen
2.61	3.02	3.42	3.82	4.13	4.32	4.54	5.34

Multipliers for relative lumen values with other series models.

CCT Multipliers – 90CRI

2400K	2700K	3000K	3500K	4000K	5000K
0.912	0.949	0.986	1	1.001	1.022

Multipliers for relative lumen values with other series color temperatures.

CCT Multipliers – 97CRI

2700K	3000K	3500K	4000K	5000K
0.889	0.955	1	1.016	1.07

Multipliers for relative lumen values with other series color temperatures.

Color Finish Multipliers (*from H = Semi Specular Clear*)

Finish code	LI	H	WMH	WH	GPH	B	MW
Finish	Specular Clear	Semi-Specular Clear	Warm Haze	Wheat	Graphite Haze	Specular Black	Matte White
Multiplier	1.25	1.00	1.02	1.02	0.72	0.55	0.95

Multipliers for relative lumen values with other color finishes.

Multi-line Order Information

Single line Ordering Information Option

SAMPLE ORDER NUMBER: **LD4C10D010TRIEM14 (All components may ship separately)**

Invoice will indicate separate fixture components (housing, trim, module) and may ship from multiple CLS facilities in separate cartons.

Domestic Preferences [1]	Housing	Lumens [2]		
[Blank]=Standard **BAA**=Buy American Act **TAA**=Trade Agreements Act	**LD4C**=LED Downlight 4-inch Nominal Aperture **LD4CCP**=LED Downlight 4-inch Nominal Aperture, Chicago Plenum	**02**=250 lumens **05**=500 lumens **08**=800 lumens **10**=1000 lumens **15**=1500 lumens **20**=2000 lumens	**25**=2500 lumens **30**=3000 lumens **35**=3500 lumens **40**=4000 lumens **45**=4500 lumens [3] **50**=5000 lumens [3]	**55**=5500 lumens [3] **60**=6000 lumens [3] **65**=6500 lumens [3] **70**=7000 lumens [3] **75**=7500 lumens [3]

Driver	Driver Options
D010 = 0-10V Dimming, 1% to 100%, 120V-277V, up to 7000 lumens (up to 3000 lumens for remote driver) **1D010** = 0-10V or line voltage Dimming, 1% to 100%, 120V, 7500 lumens (3500 to 7000 lumens for remote driver) **2D010** = 0-10V Dimming, 1% to 100%, 277V, 7500 lumens (3500 to 7000 lumens for remote driver) **3D010** = 0-10V Dimming, 1% to 100%, 347V dedicated drivers for 800 to 4000 lumens; 250, 500, 4500 and above use step down transformer (250 to 7000 lumens for remote driver) **1 driver:** 250-7000 / **2 drivers:** 7500	**Blank**=Integral driver **R**=Remote driver (offered with single driver, order remote driver separately) [6] **PD**=Plug in Driver (offered with single driver) [8]
D010TR = 0-10V Dimming, 5% to 100%,120V-277V or 120V line voltage dimming, 250- 4500 lumens (up to 3000 lumens for remote driver) **1D010TR** = 0-10V or line voltage Dimming, 5% to 100%, 120V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) **2D010TR** = 0-10V or line voltage Dimming, 5% to 100%, 277V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) **3D010TR** = 0-10V Dimming, 5% to 100%, 347V step down transformer, 250-7500 lumens (250 to 4500 lumens for remote driver) **1 driver:** 250-4500 / **2 drivers:** 5000-7500	
DE010 = 0-10V Dimming, 0% to 100%, 120V-277V, 500-7000 lumens (up to 3000 lumens for remote driver) **1DE010** = 0-10V Dimming, 0% to 100%, 120V, 7500 lumens (3500 to 7000 lumens for remote driver) **2DE010** = 0-10V Dimming, 0% to 100%, 277V, 7500 lumens (3500 to 7000 lumens for remote driver) **3DE010** = 0-10V Dimming, 0% to 100%, 0-10V Dimming, 347V step down transformer, 500-7500 lumens (500 to 7000 lumens for remote driver) **1 driver:** 500-7000 / **2 drivers:** 7500	
D5LT = Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V-277V, 500-7000 lumens (up to 3000 lumens for remote driver) **1D5LT** = Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V, 7500 lumens (3500 to 7000 lumens for remote driver) **2D5LT** =Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 277V, 7500 lumens (3500 to 7000 lumens for remote driver) **3D5LT** =Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100% 347V step down transformer, 500-7500 lumens (500 to 7000 lumens for remote driver) **1 driver:** 500-7000 / **2 drivers:** 7500	
DMX=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, 800-4500 lumens (up to 3000 lumens for remote driver) [5] **1DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) [5] **2DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 5000-7500 lumens (3500 to 4500 lumens for remote driver) [5] **3DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 800-7500 lumens, RJ45 Connection (800 to 4500 lumens for remote driver) [5] **1 driver:** 800-4500 / **2 drivers:** 5000-7500	
DMXC5=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, up to 800-4500 lumens, RJ45 Connection (up to 3000 lumens for remote driver) [5] **1DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 5000-7500 lumens, RJ45 Connection (3500 to 4500 lumens for remote driver) [5] **2DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 5000-7500 lumens, RJ45 Connection (3500 to 4500 lumens for remote driver) [5] **3DMXCF**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 250-7500 lumens, RJ45 Connection (800 to 4500 lumens for remote driver) [5] **1 driver:** 800-4500 / **2 drivers:** 5000-7500	
1DL2=Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 120V Only, 800-7500 lumens (800 to 3500 lumens for remote driver) **3DL2** = Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 347V step down transformer, 800-7500 lumens (800 to 3500 lumens for remote driver) **1 driver:** 800-3500 / **2 drivers:** 4000-7500	
DLE=Lutron Ecosystem dimming 1% to 100%, 120V-277V, 800-3500 lumens (up to 3000 lumens for remote driver) **1DLE**=Lutron Ecosystem dimming 1% to 100%, 120V, 4000-7500 lumens (3500 lumens for remote driver) **2DLE**=Lutron Ecosystem dimming 1% to 100%, 120V-277V, 4000-7500 lumens (3500 lumens for remote driver) **3DLE**=Lutron Ecosystem dimming 1% to 100%, 347V, step down transformer, 800-7500 lumens (800-3500 lumens for remote driver) **1 driver:** 800-3500 / **2 drivers:** 4000-7500	
DLV=Low voltage dimming driver (1-100%) for use with DLVP system 800-3000 lumens [6]	

Options [6]	
EMBOD=Bodine® Emergency Module with Remote Test Switch [10]	**IEM7**=7W Emergency Module with Integral Test Switch [22]
EMBOD6ST=Bodine® 6W Self Test Emergency Module with Remote Test Switch	**IEM14**=14W Emergency Module with Integral Test Switch [22]
EM7=7W Emergency Module with Remote Test Switch	**EMV7**=7W Low Voltage Emergency Module with Remote Test Switch [7]
EM14=14W Emergency Module with Remote Test Switch	**EMV14**=14W Low Voltage Emergency Module with Remote Test Switch [7]
EMBOD7ST=Bodine® Self Test Emergency Module [10]	**ETRD**=Emergency transfer device [31]
IEMBOD=Bodine® Emergency Module with Integral Test Switch [10] [22]	**WPST** =Factory installed Wavelinx (includes control module, sensor, cable, tilemount and ceiling mount sensor) [11] [13] **WLST** =Factory installed WaveLinx LITE Sensor Kit [11] [12] **WPN** = WaveLinx PRO Wireless Node without sensor [34]

Continued on next page.

Multi-line Order Information

SAMPLE ORDER NUMBER: **EU4C10209035**

Domestic Preferences [1]	Power Module	Lumen Levels [2]	CRI [2]	Color	
[Blank]=Standard **BAA**=Buy American Act **TAA**=Trade Agreements Act	**EU4C**=4-inch Universal LED Module	**For use with one driver** **0208IC**=250, 500, 800 lumens, IC Rated (for use with all drivers, min 500 lumen with DE010 and D5LT, min 800 lumens with DLVP, Lutron and DMX) **1020**= 1000, 1500, 2000 lumens **1015IC**=1000, 1500 lumens IC Rated **2540**=2500, 3000, 3500, 4000 lumens (For use with Lutron 3000-3500, DLVP 3000 lumens, DMX, D010, D010TR, D5LT and DE010 3000-4000) **4560**=4500, 5000, 5500, 6000 lumens (For use with DMX and D010TR 4500 lumens, D010, D5LT and DE010 4500-6000) [3] **6570**=6500, 7000 lumens (For use with D010, D5LT and DE010) [3] **For use with two drivers** **4075**=4000, 4500, 5000, 5500, 6000, 6500, 7000, 7500 lumens (For use with Lutron 4000-7500, D010TR & DMX 5000, D010, D5LT & DE010 7500 lumen) [3]	**90**=90 CRI Minimum **97**=97 CRI Minimum	**90 CRI** **24**=2400K **27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K	**97 CRI** **27**=2700K **30**=3000K

SAMPLE ORDER NUMBER: **4LBM2H**

Domestic Preferences [1]	Trim	Reflector		Flange	Finish	Options
[Blank]=Standard **BAA**=Buy American Act	**4LB**=4" LED	**N**=Narrow, Spun Aluminum [29] **M**=50° Cutoff, Medium Beam Reflector, Spun Aluminum **MD**=45° Cutoff, Medium Beam Reflector, Spun Aluminum **W**=Wide, Spun Aluminum **S**=Shallow, Spun Aluminum **HY**=Hyperbolic medium beam [29] **PS**=Non-Conductive Shallow, Injection Molded white [16] [17] **CS**=Cast Shallow, Die Cast Aluminum **BA**= Spun Aluminum Baffle [24]	**Wall Wash** **SWN**=Single wall wash, spun aluminum **DWN**=Double wall wash, spun aluminum **CW**=Corner wall wash, spun aluminum **LSWW**=Lensed single wall wash, spun aluminum **LDWW**=Lensed double wall wash, spun aluminum	**0**=White polymer trim ring **1**=Self flanged [18] **2**=White painted self flanged **4**=Knife edge rimless use with die cast only [19]	**LI**=Specular Clear [20] **H**=Semi-Specular Clear [20] **WMH**=Warm Haze [20] **WH**=Wheat [20] **GPH**=Graphite Haze [20] **B**=Specular Black [20] **MW**=Matte White **MB**=Matte Black [21] **MMS**=Matte Metallic Silver [21]	**E**=Integral Emergency Test Switch Hole [22]

REQUIRED if Remote Driver (R) is specified

SAMPLE ORDER NUMBER: **RC10010D010TREM7**

Domestic Preferences [1]	Remote Drivers	Lumens [2] [14]		
[Blank]=Standard **BAA**=Buy American Act **TAA**=Trade Agreements Act	**RC100**=Remote 100ft **RC75**=Remote 75ft **RC50**=Remote 50ft **RC25**=Remote 25ft **RC15**=Remote 15ft **RC5**=Remote 5ft **RC2**=Remote 2ft	**02**=250 lumens **05**=500 lumens **08**=800 lumens **10**=1000 lumens **15**=1500 lumens	**20**=2000 lumens **25**=2500 lumens **30**=3000 lumens **35**=3500 lumens **40**=4000 lumens **45**=4500 lumens	**50**=5000 lumens **55**=5500 lumens **60**=6000 lumens **65**=6500 lumens **70**=7000 lumens

Continued on next page.

Multi-line Order Information

Driver
D010 = 0-10V Dimming, 1% to 100%, 120V-277V, 250-3000 lumens **1D010** = 0-10V Dimming, 1% to 100%, 120V, 3500-7000 lumens **2D010** = 0-10V Dimming, 1% to 100%, 277V, 3500-7000 lumens **3D010** = 0-10V Dimming, 1% to 100%, 347V dedicated drivers for 800 to 3000 lumens; 250, 500, 3500-7000 lumens use step down transformer
D010TR = 0-10V Dimming, 5% to 100%,120V-277V or 120V line voltage dimming, 120V-277V, 250- 3000 lumens **1D010TR** = 0-10V or line voltage Dimming, 5% to 100%, 120V, 3500-4500 lumens **2D010TR** = 0-10V Dimming, 5% to 100%, 277V, 3500-4500 lumens **3D010TR** = 0-10V or line voltage Dimming, 5% to 100% 347V step down transformer, 250-4500 lumens
DE010 = 0-10V Dimming, 0% to 100%, 120V-277V, 500-3000 lumens **1DE010** = 0-10V Dimming, 0% to 100%, 120V, 3500-7,000 lumens **2DE010** = 0-10V Dimming, 0% to 100%, 277V, 3500-7,000 lumens **3DE010** = 0-10V Dimming, 0% to 100%, 347V step down transformer, 500-7,000 lumens
D5LT = Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V-277V, 500-3000 lumens **1D5LT** = Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 120V, 3500-7,000 lumens **2D5LT** =Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100%, 277V, 3500-7,000 lumens **3D5LT** =Fifth Light® (DALI T6) Logarithmic Dimming, 0% to 100% 347V step down transformer, 500-7,000 lumens
DMX = DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V, 800-3000 lumens [5] **1DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 3500-4500 [5] **2DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 3500-4500 [5] **3DMX**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 800-4500 [5]
DMXC5 = DMX/RDM Logarithmic Dimming, 0% to 100%, 120V-277V up to 800-3000 lumens, RJ45 Connection [5] **1DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 120V, 3500-4500 lumens, RJ45 Connection [5] **2DMXC5**=DMX/RDM Logarithmic Dimming, 0% to 100%, 277V, 3500-4500 lumens, RJ45 Connection [5] **3DMXCF**=DMX/RDM Logarithmic Dimming, 0% to 100%, 347V step down transformer, 800-4500 lumens, RJ45 Connection [5]
1DL2=Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 120V Only, 25' Max remote length, 800-3500 lumens **3DL2** = Lutron® Hi-Lume Forward Phase Dimming, 1% to 100%, 347V step down transformer, 25' Max remote length, 800-3500 lumens
DLE = Lutron Ecosystem dimming 1% to 100%, 120V-277V, 25' Max remote length, 800-3000 lumens **1DLE**=Lutron Ecosystem dimming 1% to 100%, 120V, 25' Max remote length, 3500 lumens **2DLE**=Lutron Ecosystem dimming 1% to 100%, 277V, 25' Max remote length, 3500 lumens **3DLE**=Lutron Ecosystem dimming 1% to 100%, 347V, step down transformer, 25' Max remote length, 800-3500 lumens
DLV = Low voltage dimming driver (1-100%) for use with DLVP system, 800-3000 lumens [6]

Options		Controls
EMBOD=Bodine® Emergency Module with Remote Test Switch [10] **EMBOD6ST**=Bodine® 6W Self Test Emergency Module with Remote Test Switch **EM7**=7W Emergency Module with Remote Test Switch **EM14**=14W Emergency Module with Remote Test Switch	**EMBOD7ST**=Bodine® Self Test Emergency Module with Remote Test Switch [10] **EMV7**=7W Low Voltage Emergency Module with Remote Test Switch [7] **EMV14**=14W Low Voltage Emergency Module with Remote Test Switch [7] **ETRD**=Emergency transfer device [31]	**WPST**=Factory installed Wavelinx (includes control module, sensor, cable, tilemount and ceiling mount sensor) [11] [13] **WLST**=Factory installed WaveLinx LITE Sensor Kit [11] [12] **WPN** = WaveLinx PRO Wireless Node without sensor [34]

Accessories (*Order separately*) [25]

TRM4P=White metal trim ring [26]
LGSKT4IP66=IP66 Gasket Kit
DT4RF=4 inch frosted acrylic ring [28]

PRR4=Rimless Plaster Ring [26]
RKP4=Knife Edge plaster Ring [27]

RPM4MW=Rimless Millwork Ring, Matte White [26]
RPM4MB=Rimless Millwork Ring, Matte Black [26]
RKM4MW=Knife Edge Millwork Ring, Matte White [27]
RKM4MB=Knife Edge Millwork Ring, Matte Black [27]

HSA4=Slope Adapter for 4" Aperture Housings, Specify Slope [33]

Connected Lighting Systems [6] [11]
WPST = Field installed WaveLinx sensor Kit [13]
WLST = Field installed WaveLinx LITE Sensor Kit [12]

Transformers
H347=H347 for 5500 lumens and below
H347200=347 to 120V Step Down Transformer, 200VA

Bar Hangers
HB50=C-channel Bar Hanger, 50" Long, Pair
RMB22=Wood Joist Bar Hanger, 22" Long, Pair

Notes:

1. Only product configurations with these designated prefixes are built to be compliant with the Buy American Act of 1933 (BAA) or Trade Agreements Act of 1979 (TAA), respectively. Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analysed under domestic preference requirements. Offered with spun aluminum narrow (N), medium (M) and wide (W) trims.

2. Nominal Lumens will vary depending on selected color, CRI, driver and reflector finish. Reference Multiplier tables.

3. Product is marked spacing. Reference table on page 4 for the spacing details.

5. DMX fixtures default to full on upon loss of DMX signal.

6. Not available with Chicago Plenum.

7. ULus listed only

8. Offered with
- D010, D5LT, DE010 up to 7000 lumens
- D010TR, DMX up to 4500 lumens
- DLE, DL2 up to 3500 lumens

9. Not available with 5500 lumens

10. Not available for 6500-7000 lumens

11. Refer to system specifications for additional information,features, and benefits. Order either factory installed option or accessory. Use with 0-10V driver.

12. WLST = WaveLinx LITE tilemount sensor kit for daylight dimming, PIR motion sensing, use with D010 only (Refer to WaveLinx LITE system specifications)

13. WPST = WaveLinx wireless sensor kit for daylight dimming, PIR motion sensing, and optional RLTS - Real Time Location Services, use with 0-10V only.

14. IC rated up to 3000 lumens

15. Spun aluminum only

16. PS available in self-flanged MW finish only

17. Offered up to 2000 lumens

18. Flange is the same finish as the reflector

19. Requires knife edge accessory ring

20. Anodized or spun reflectors

21. Die cast only

22. Available with narrow (N), medium (M) and medium 45 degree (MD) Spun Aluminum trims. Required for use with all IEMBOD, IEM7, IEM14,IEMV7 and IEMV14 housings. Not offered with remote driver.

23. Offered with DLVP up to 3000 lumens.

24. Black or white paint.

25. Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information.

26. Order trim with polymer trim ring (Consult specification sheet for color ordering information and options).

27. Order die cast trim with flange type 4

28. Order with self flanged trim.

29. Use only with single LED/driver.

29. If using remote driver order battery and controls with the remote driver.

30. 120V-277V

31. Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others).

32. Non-IC

33. Not recommended for use with Wall Wash

34. WPN = WaveLinx PRO wireless node provides luminaire-level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with 0-10V driver only.

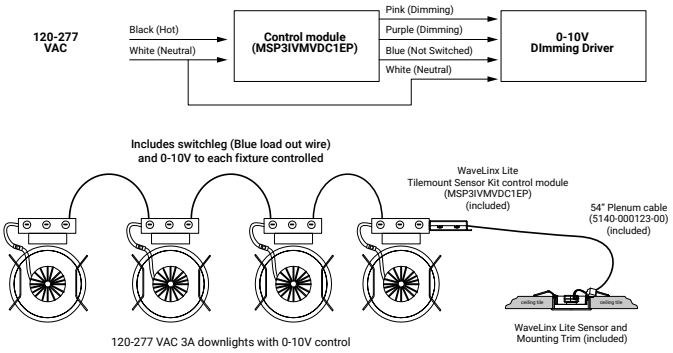
Connected Solutions

WaveLinx LITE - WLST Tilemount Sensor

- Intuitive Android™ or Apple® iOS® app for basic system code compliant set up and configuration via Bluetooth
- Up to 28 unique areas per project site (WaveLinx LITE Bluetooth network)
- Up to 50 devices for an area, any one of 16 control zones, up to 6 occupancy sets, and custom lighting scenes
- Automatic occupancy or vacancy, sensor sensitivity, daylight dimming, etc. configurable through the app
- Refer to the WaveLinx system specifications for details

Device Security | Manual Dimmer | Occupancy Sensor | Daylighting Control | Manually Switched ON/OFF | Tuning Control | Lumen Maintenance Control | Scenes

WaveLinx LITE WLST Tilemount Wiring Diagram



WaveLinx LITE Bluetooth Enabled System

WaveLinx PRO Wireless – WPST Tilemount Sensor

- WaveLinx PRO Wireless functionality configures zones and customizes settings from one secure mobile app
- Automatic code commissioning that meets the strictest codes
- Fixtures and sensors integrate with Wireless Area Controller, Wall Stations, and Control Devices
- Stand-Alone Offices or Entire Building Network Installations

Downlights with tilemount sensor wireless communication
Highly efficient LED fixtures

WaveLinx Area Controller
Provides centralized coordination of multiple area control options

Wireless Wall Station/Receptacle
Provides customized wireless control of each area

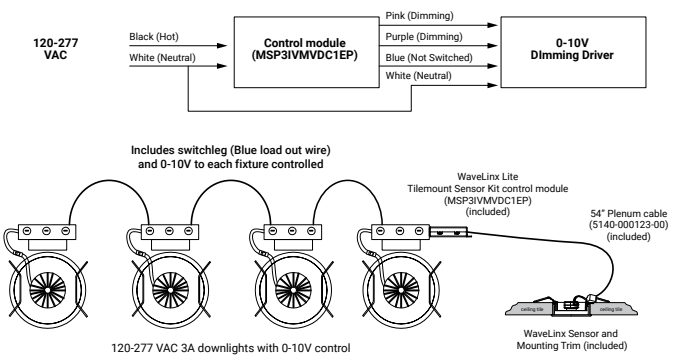
Mobile Applications
Provides personalized, local control from a tablet or smartphone

WaveLinx mobile app settings

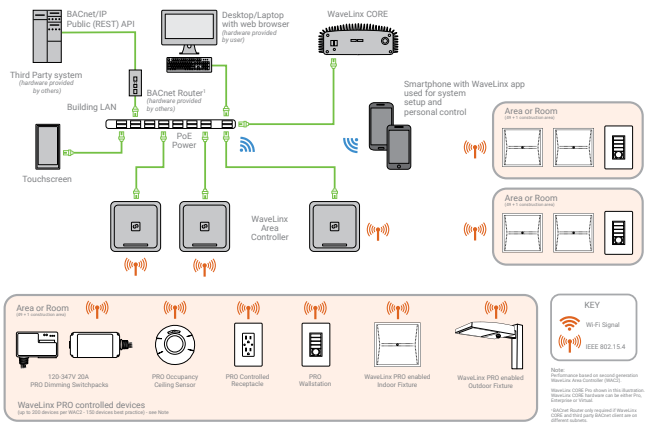
Manual Dimmer | Occupancy Sensor | Lumen Maintenance Control | Daylighting Control

Receptacle Control | Tuning Control | Scheduling | Manually Switched ON/OFF | Demand Response

WaveLinx PRO WPST Tilemount Wiring Diagram



WaveLinx CORE Building Management Integration



Connected Solutions

WaveLinx PRO Wireless Node - WPN

- WaveLinx Wireless functionality configures zones and customizes settings from one secure mobile app
- Automatic code commissioning that meets the strictest codes
- Fixtures and sensors integrate with WaveLinx Area Controller, Wall Stations, and Control Devices
- Stand-Alone Offices or Entire Building Network Installations

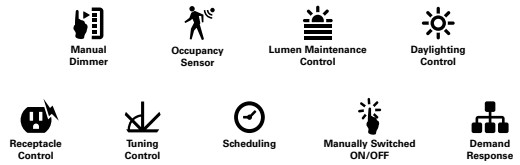
Downlights with wireless communication
Highly efficient LED fixtures

WaveLinx Area Controller
Provides centralized coordination of multiple area control options

Wireless Wall Station/Receptacle
Provides customized wireless control of each area

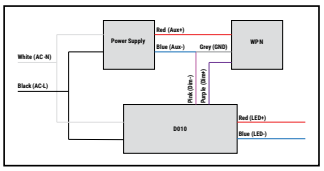
Mobile Applications
Provides personalized, local control from a tablet or smartphone

WaveLinx mobile app settings

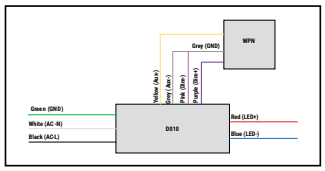


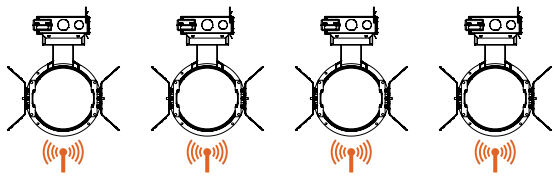
WaveLinx PRO Wireless Node (WPN) Wiring Diagram

For 0-10V drivers 250 lumens and Tunable White



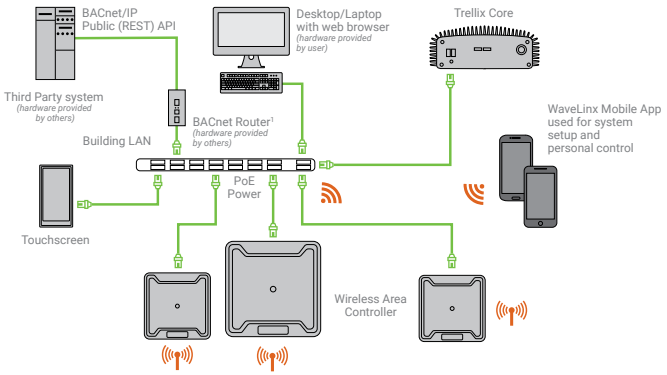
For 0-10V drivers 500 lumens and over





120-277 VAC 3A downlights with 0-10V control

WaveLinx CORE Building Management Integration



Cooper Lighting Solutions
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

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Specifications and dimensions subject to change without notice.

HALO

Description

The Mini Integrated LED Track fixture series is sleek, compact and ideal for accent or display lighting. Featuring die cast construction with an elegant design, these integrated luminaires are ideal for retail store construction, hospitality, other light commercial, or residential applications where superior performance is desired. The mini-series is sized and designed to replace traditional MR16 lamp holders but delivers additional lumens, longer life and excellent optical performance.

Catalog #		Type	
Project			
Comments		Date	
Prepared by			

Specification Features

Quick Lock Adapter
- Attaches electrically and mechanically anywhere along the track.
- Includes discrete locking tab that locks the luminaire on the track and allows for easy removal and repositioning.

LED Light Engine
- Chip on board LED provides a uniform source with high efficiency and no pixilation.
- Available in 90 CRI minimum, R9 greater than 50 and color accuracy within 3 SDCM provide uniformity.
- Available in 2700K, 3000K, 3500K and 4000K fixed CCT.

Optics
- The design allows for optics to be changed in the field and adjust as neccesary.
- Available in spot, flood and narrow flood distributions

Media
- Precision machined trim ring contains unique locking mechanism, and can accept 1 piece of standard 2" MR16 media.
- See below for list of compatible media accessories and refer to instruction document for further details on installation.

Luminaire Arm
- Arm allows the lamp housing tilt to adjust 90° vertically and 355° horizontally. This enables a clean look while providing full aiming capabilities.

Dimming
- Designed for continuous dimming capability to nominally 5% with many 120V Leading Edge (LE) and Trailing Edge (TE) Phase Control dimmers.
- Consult dimming guide for list of recommended dimmers or dimmer manufacturer for compatibility and conditions of use
- Dimming only available with 120V configurations.

Driver
- Fixtures are equipped with a 15W integral Universal voltage (120V – 277V), 50/60 Hz constant current driver that provides noise free operation.

Compliance
- cULus certified for use with Halo single circuit PowerTrac & Global® TEK/HTEK track
- EMI/RFI emissions per FCC 47CFR Part 15 Class B consumer limits.
- Contains no mercury or lead and RoHS compliant.
- Photometric testing in accordance with IES LM-79-08.
- Lumen maintenance projections in accordance with IES LM-80-08 and TM-21-11.

Warranty
Five year limited warranty, consult website for details.
cooperlighting.com

Halo Mini Series L812

LED Track Head

90 CRI

Efficiency Standards T24 Can be used to comply with 2016 Title 24 Part 6 LED Light Source Requirements (JA8)

UL CERTIFIED SAFETY

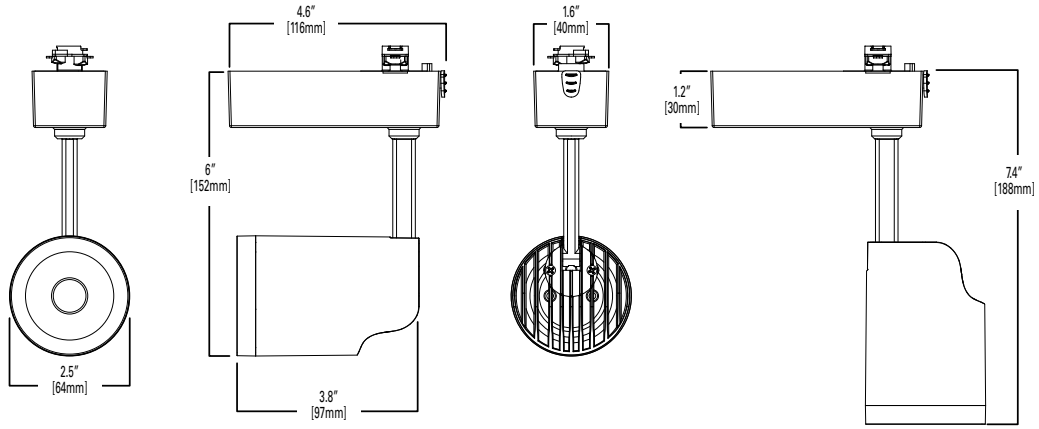
DLC QPL LISTED

CBCP	800	1100
Spot 15°	6123	9646
Narrow Flood 22°	4385	5788
Flood 37°	1791	2558

Lighting Data - 3000K Spot		
Lumens	794	1131
Lumens per Watt	75.6	73.0

Energy Data		
Input Power	10.5W	15.5W
Power Factor	≥.99	≥.99
Input Current	0.09	0.128

Dimensions



Ordering Information

SAMPLE NUMBER: L81211SP9030SL (Halo Track adapter, 1100 lumen, Spot Distribution, 90 CRI, 3000K, with Silver Finish)

Track System	Series / Style	Lumen Package	Distribution	CRI	Color Temp	Finish	Voltage
L= Halo and Lazer Power Trac **LJ**=Juno® Track[1] **LL**=Lightolier® Track[2]	**812**=Mini LED Accent Cylinder	**11**=1100 lumens **08**=800 lumens	**SP**=Spot (15°) **NF**=Narrow Flood (22°) **FL**=Flood (38°)	**90**=90	**27**=2700K **30**=3000K **35**=3500K **40**=4000K	**P**=White **MB**=Matte Black **SL**=Silver	**Blank**=120V

NOTES: 1. Juno® T single circuit and 2-circuit track contact. Juno® is a registered trademark of Juno® Lighting. **2.** Lightolier® Lyfespan 6000 single circuit and 2 circuit track contact. Lightolier® is a registered trademark of Philips Lighting.

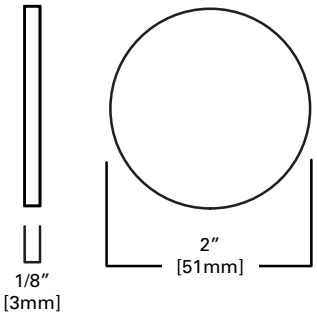
Select models are DesignLights™ Consortium Qualified. Refer to www.designlights.org Qualified Products List under Family Models for details.

Accessories (order separately)

L100 Series
2" 50mm UV and Color Filters

For use with MR16 and LED lampholders. Make a power lighting statement by injecting soft or intense hues to accent any space.

L112=Red Gel Filter
L114=Ultraviolet, Dichoric Filter
L120=Red, Dichoric Filter
L121=Amber, Dichoric Filter
L122=Yellow, Dichoric Filter
L123=Green, Dichoric Filter
L124=Daylight Blue, Dichoric Filter
L125=Blue, Dichoric Filter
L127=Cosmetic (2700K), Dichoric Filter
L131=Amber, Gel Filter



L100 Series UV and Color Filters

L100 Series
Optical Lenses

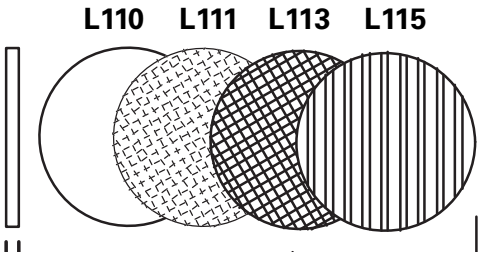
L110N=Diffuse Sandblasted Lens
Provides an even beam spread from MR16 lamps - especially useful in wall washing.

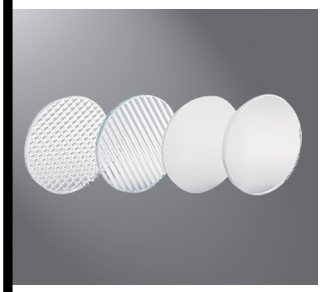
L111=Soft Focus Lens
Smooths irregular beam pattern while maintaining high controlled illumination levels and beam angles of MR16 lamps.

L113=Prismatic Spread Lens
Provides a symmetrical broadening of MR16 lamp beams. Suitable when a wide, uniform light distribution is required.

L115=Linear Spread Lens
Fans out the MR16 beam 55° (27-1/2° to each side) to produce a wide rectangular pattern.

L100MB=Expanded metal louver
Miniature black finished hexagonal-cell louver - controls light spill while retaining lamp optics.





L100 Series Optical Lenses

811xOPK
Interchangable Optics

811SPOPK = 811 or 812 Spot Optic
811NFOPK = 811 or 812 Narrow Flood Optic
811FLOPK = 811 or 812 Flood Optic

811xOPK Interchangle Optic

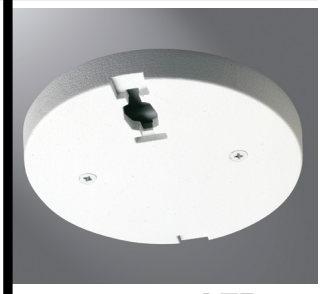
L1973
Track Monopoint

L1973=description

L1973 Monopoint

LZR210
Lazer Track Monopoint

LZR210=description



LZR210 Monopoint

Photometry - 800 Lumen

L812 - MB

Color Temp = 3000K	0 deg Aiming Angle Horizontal Footcandles			
4000K Multiplier = 1.083	MH	FC	L	W
Spot: 15D **CBCP:** 6123 **Lumens:** 794 **LPW:** 76	5'	244.9	1.2	1.2
	7.5'	108.9	2	2
	10'	61.2	2.6	2.6
	12.5'	39.2	3.2	3.2
	15'	27.2	4	4

30 deg Aiming Angle Horizontal Footcandles				
MH	FC	L	W	CB
5'	161	1.7	1.4	2.9
7.5'	71.5	2.6	2.2	4.3
10'	40.2	3.5	3	5.8
12.5'	25.8	4.4	3.8	7.2
15'	17.9	5.3	4.6	8.7

30 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	99.4	2.7	1.4	5.2
4'	55.9	3.7	2	6.9
5'	35.8	4.6	2.4	8.7
6'	24.8	5.5	3	10.4

60 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	447.1	1	0.8	1.7
4'	251.5	1.3	1.2	2.3
5'	161	1.7	1.4	2.9
6'	111.8	2.1	1.8	3.5

Color Temp = 3000K	0 deg Aiming Angle Horizontal Footcandles			
4000K Multiplier = 1.083	MH	FC	L	W
Spot: 22D **CBCP:** 4385 **Lumens:** 779 **LPW:** 75	5'	175.4	1.6	1.6
	7.5'	78	2.6	2.6
	10'	43.8	3.4	3.4
	12.5'	28.1	4.4	4.4
	15'	19.5	5.2	5.2

30 deg Aiming Angle Horizontal Footcandles				
MH	FC	L	W	CB
5'	118.8	2.1	2	2.9
7.5'	52.8	3.3	3	4.3
10'	29.7	4.4	4	5.8
12.5'	19	5.6	5	7.2
15'	13.2	6.6	6	8.7

30 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	80.2	2.9	1.8	5.2
4'	45.1	3.9	2.4	6.9
5'	28.9	4.9	3	8.7
6'	20	5.9	3.6	10.4

60 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	330.1	1.3	1.2	1.7
4'	185.7	1.7	1.6	2.3
5'	118.8	2.1	2	2.9
6'	82.5	2.6	2.4	3.5

Color Temp = 3000K	0 deg Aiming Angle Horizontal Footcandles			
4000K Multiplier = 1.083	MH	FC	L	W
Spot: 38D **CBCP:** 1791 **Lumens:** 819 **LPW:** 79	5'	71.6	3	3
	7.5'	31.8	4.4	4.4
	10'	17.9	6	6
	12.5'	11.5	7.4	7.4
	15'	8	9	9

30 deg Aiming Angle Horizontal Footcandles				
MH	FC	L	W	CB
5'	50.8	3.5	3.2	2.9
7.5'	22.6	5.2	5	4.3
10'	12.7	7.1	6.6	5.8
12.5'	8.1	8.9	8.2	7.2
15'	5.6	10.6	10	8.7

30 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	45	3.4	2.6	5.2
4'	25.3	4.6	3.6	6.9
5'	16.2	5.8	4.4	8.7
6'	11.3	6.9	5.4	10.4

60 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	141.1	2	2	1.7
4'	79.4	2.8	2.6	2.3
5'	50.8	3.5	3.2	2.9
6'	35.3	4.2	4	3.5

Notes and Definitions

Beam spread is to 50% center beam candlepower (CBCP).

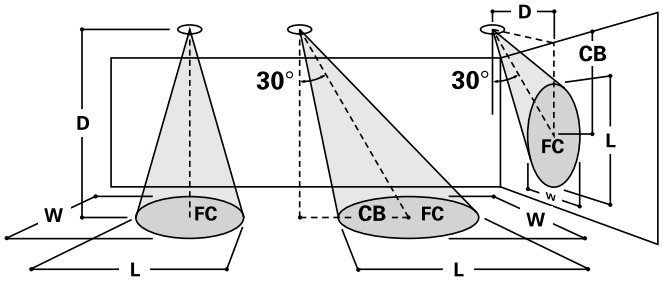
D= Distance in feet to floor or wall.

FC= Footcandles on floor or wall at center beam aiming location.

L= Effective Visual Beam length in feet (50% of maximum footcandle level)

W= Effective Visual Beam width in feet (50% of maximum footcandle level)

CB= Distance in feet across or down to center beam location



Cooper Lighting Solutions
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

Specifications and dimensions subject to change without notice.

Photometry - 1100 Lumen

L812 - MB

Color Temp = 3000K	0 deg Aiming Angle Horizontal Footcandles			
4000K Multiplier = 1.118	MH	FC	L	W
Spot: 15D CBCP: 9646 Lumens: 1131 LPW: 73	5'	385.8	1.2	1.2
	7.5'	171.5	1.8	1.8
	10'	96.5	2.6	2.6
	12.5'	61.7	3.2	3.2
	15'	42.9	3.8	3.8

30 deg Aiming Angle Horizontal Footcandles				
MH	FC	L	W	CB
5'	258.4	1.6	1.4	2.9
7.5'	114.8	2.5	2.2	4.3
10'	64.6	3.3	3	5.8
12.5'	41.3	4.2	3.6	7.2
15'	28.7	5.1	4.4	8.7

30 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	161.8	2.5	1.4	5.2
4'	91	3.5	1.8	6.9
5'	58.3	4.3	2.2	8.7
6'	40.5	5.2	2.8	10.4

60 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	717.7	1	0.8	1.7
4'	403.7	1.3	1.2	2.3
5'	258.4	1.6	1.4	2.9
6'	179.4	2	1.8	3.5

Color Temp = 3000K	0 deg Aiming Angle Horizontal Footcandles			
4000K Multiplier = 1.118	MH	FC	L	W
Spot: 22D CBCP: 5788 Lumens: 1104 LPW: 71	5'	231.5	1.8	1.8
	7.5'	102.9	2.6	2.6
	10'	57.9	3.6	3.6
	12.5'	37	4.6	4.6
	15'	25.7	5.4	5.4

30 deg Aiming Angle Horizontal Footcandles				
MH	FC	L	W	CB
5'	157.5	2.3	2	2.9
7.5'	70	3.5	3	4.3
10'	39.4	4.6	4.2	5.8
12.5'	25.2	5.8	5.2	7.2
15'	17.5	6.8	6.2	8.7

30 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	109.8	2.8	1.8	5.2
4'	61.8	3.8	2.4	6.9
5'	39.5	4.8	3	8.7
6'	27.5	5.8	3.8	10.4

60 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	437.6	1.3	1.2	1.7
4'	246.2	1.8	1.6	2.3
5'	157.5	2.3	2	2.9
6'	109.4	2.7	2.4	3.5

Color Temp = 3000K	0 deg Aiming Angle Horizontal Footcandles			
4000K Multiplier = 1.118	MH	FC	L	W
Spot: 38D CBCP: 2558 Lumens: 1242 LPW: 80	5'	102.3	3	3
	7.5'	45.5	4.6	4.6
	10'	25.6	6.2	6.2
	12.5'	16.4	7.8	7.8
	15'	11.4	9.4	9.4

30 deg Aiming Angle Horizontal Footcandles				
MH	FC	L	W	CB
5'	73.5	3.8	3.4	2.9
7.5'	32.7	5.6	5.2	4.3
10'	18.4	7.6	7	5.8
12.5'	11.8	9.5	8.6	7.2
15'	8.2	11.4	10.4	8.7

30 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	69.3	3.3	2.8	5.2
4'	39	4.5	3.6	6.9
5'	25	5.6	4.6	8.7
6'	17.3	6.8	5.6	10.4

60 deg Aiming Angle Vertical Footcandles on Wall				
D	FC	L	W	CB
3'	204.2	2.2	2	1.7
4'	114.9	3	2.8	2.3
5'	73.5	3.8	3.4	2.9
6'	51.1	4.5	4.2	3.5

Notes and Definitions

Beam spread is to 50% center beam candlepower (CBCP).

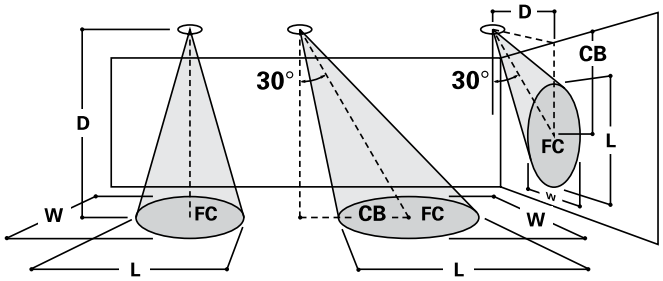
D= Distance in feet to floor or wall.

FC= Footcandles on floor or wall at center beam aiming location.

L= Effective Visual Beam length in feet (50% of maximum footcandle level)

W= Effective Visual Beam width in feet (50% of maximum footcandle level)

CB= Distance in feet across or down to center beam location



COOPER Lighting Solutions

Cooper Lighting Solutions
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

Specifications and dimensions subject to change without notice.

HALO

DESCRIPTION

Miniature size, decorator finishes, push-in connectors, economy, all combine to make single-circuit Miniature Trac perfect for residential or commercial use. Polarized connectors and end caps are molded polycarbonate. Halo Miniature Track accepts both Halo and Lazer-by-Halo lampholders.

Catalog #		Type
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

A. Structural
- Extruded aluminum .060" [1.5mm] nominal wall thickness

B. Line Conductor
- Solid copper bus bars [cross section equivalent to #12 AWG wire].

C. Insulating Liner
- Extruded polyvinyl insulator.

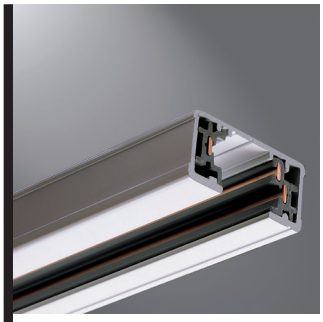
D. Ground Conductor
- Exclusive independent grounding bus conductor. Maintains an independent positive ground #12 AWG path between lampholder, Trac channel and building's ground system.

E. Neutral Conductor
- Cross section equivalent of #12 AWG wire.

F. Polarity Indicator (Neutral)
- Visual polarity groove indicates proper electrical installation of lampholder adapter.

Listings
- cULus listed for use with Halo and Lazer-by-Halo lampholders.

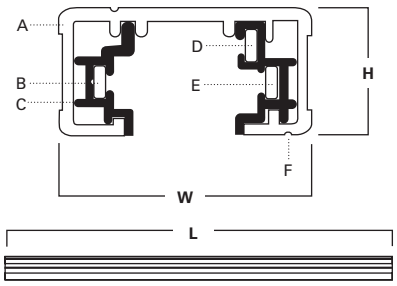
Mounting
- Track system is recommended for ceiling mount only. For alternate mounting methods consult factory.



L650, L651
L652, L653

MINIATURE SINGLE CIRCUIT TRAC SYSTEM

Power -Trac



	L	W	H
L650 2' Nominal	20-1/8" [511mm]	1-3/8" [35mm]	11/16" [18mm]
L651 4' Nominal	44-1/8" [1121mm]	1-3/8" [35mm]	11/16" [18mm]
L652 8' Nominal	92-1/8" [2340mm]	1-3/8" [35mm]	11/16" [18mm]
L653 12' Nominal	140-1/8" [3559mm]	1-3/8" [35mm]	11/16" [18mm]

ORDERING INFORMATION

SAMPLE NUMBER: L651MB

Track	Finishes	Connectors (Order Separately)	Accessories (Order Separately)	Current Limiters (Order Separately)
L650= 2' **L651**= 4' **L652**= 8' **L653**= 12'	**P**=White **MB**=Black	**L900**=Outlet Box Cover **L901**=Live End Connector **L902**=Flexible Connector **L903**=Straight Connector **L904**=L Connector **L905**=T Connector **L906**=X Connector **L907**=Outlet Box for use with T-Bar ceiling **L908**=Mini Joiner **L909**=Floating Canopy and Connector **L950**=Cord and Plug Connector **L979**=Conduit Continuation Kit **L980**=Live End Conduit Adapter **DE600**=Dead End Finishes **P**=White **MB**=Black	**L951**=Wire Way Cover for Pendant Assembly Kit **L983**=T-Bar Attachment Clip **L992**=Pendant Kit Assembly **L48**=48" Steel Stem **L994**=Pendant Adapter Finishes **P**=White **MB**=Black	Current Limiter - End Feed **LC901CB120**=120W (1A @ 120V) **LC901CB300**=300W (2.5A @ 120V) **LC901CB600**=600W (5A @ 120V) **LC901CB960**=960W (8A @ 120V) **LC901CB1200**=1200W (10A @ 120V) Current Limiter - Center Feed **LC903CB120**=120W (1A @ 120V) **LC903CB300**=300W (2.5A @ 120V) **LC903CB600**=600W (5A @ 120V) **LC903CB960**=960W (8A @ 120V) **LC903CB1200**=1200W (10A @ 120V) Finishes **P**=White **MB**=Black

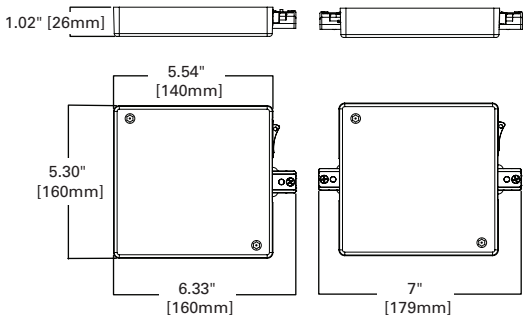
LC901, LC903 Current Limiter - End and Center Feeds

End-feed and Center-feed capable:
Five breaker sizes are available. Consult factory if other sizes are required. Can be utilized on hard or grid ceilings. Can be used with pendant suspended track. Breaker can be used as an on-off switch. Breaker features a "tripped" condition indicator. cULus Listed.

ORDERING INFORMATION

SAMPLE NUMBER: LC901CB120P

Feed Type	Circuit 1 Breaker	Finish
LC901= Halo Power-Trac 1-Circuit End Feed **LC903**= Halo Power-Trac 1-Circuit Center Feed	**CB120**=120W (1A @120V) **CB300**=300W (2.5A @120V) **CB600**=600W (5A @120V) **CB960**=960W (8A @120V) **CB1200**=1200W (10A @120V)	**P**=White **MB**=Black



Sample catalog number: LC901CB120P

Consult factory for Single Circuit Center-feed requiring two circuit breakers.

LC901
LC903

T24 Can be used to comply with California Title 24 High Efficacy requirements
T20 Certified to California Title 20 Appliance Database

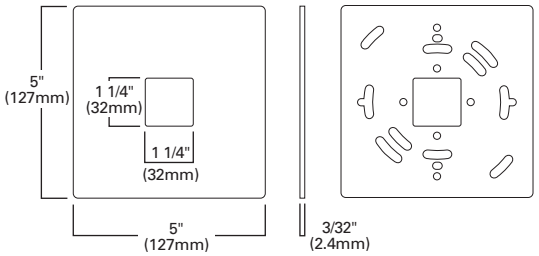
L900 - Outlet Box Cover

Can be used at any electrical feed connection point (Live, Straight, L, T or X). Drill guides on back for virtually all standard outlet boxes. Size: 5" sq. Screws included.
Color codes: P (White), MB (Black)

ORDERING INFORMATION

SAMPLE NUMBER: L900P

Connector	Finish
L900= Outlet Box Cover	**P**=White **MB**=Black



L900

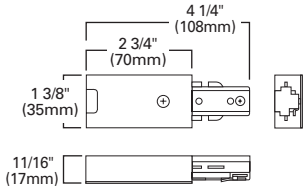
L901 - Live End Connector

To start a run.
Color codes: P (White), MB (Black)

ORDERING INFORMATION

SAMPLE NUMBER: L901P

Connector	Finish
L901= Live End Connector	**P**=White **MB**=Black



L901

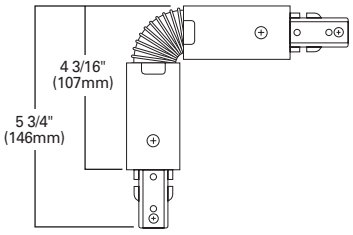
L902 - Flexible Connector

To connect two track sections at any angle up to 90° in either plane or wall to ceiling or pitched ceiling applications.
Color codes: P (White), MB (Black)

ORDERING INFORMATION

SAMPLE NUMBER: L902P

Connector	Finish
L902= Flexible Connector	**P**=White **MB**=Black



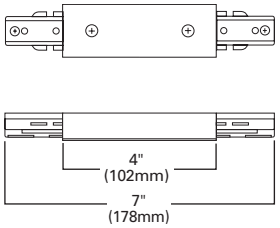
L902

COOPER Lighting Solutions

L903 - Straight Connector

To connect two track sections end-to-end. L903 differs from mini connector L908 in that it provides a center feed option and is longer.May be used as feed point.

Color codes: P (White), MB (Black)



L903

ORDERING INFORMATION

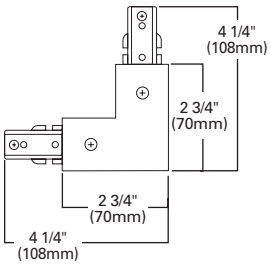
SAMPLE NUMBER: L903P

Connector	Finish
L903= Straight Connector	**P**=White **MB**=Black

L904 - L Connector

To connect two track sections at a right angle. Field adjustable for either right hand or left hand application. May be used as feed point.

Color codes: P (White), MB (Black)



L904

ORDERING INFORMATION

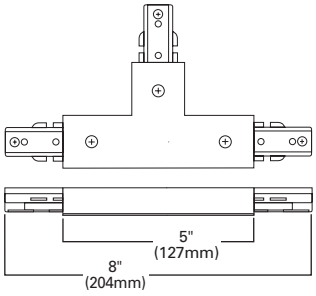
SAMPLE NUMBER: L904P

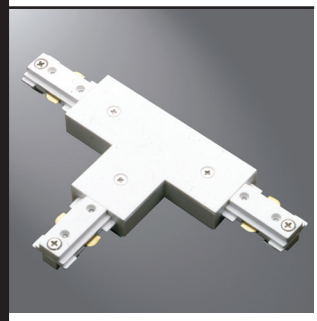
Connector	Finish
L904= L Connector	**P**=White **MB**=Black

L905 - T Connector

To connect three track sections into a T configuration. Field adjustable for either right hand or left hand application. May be used as feed point.

Color codes: P (White), MB (Black)





L905

ORDERING INFORMATION

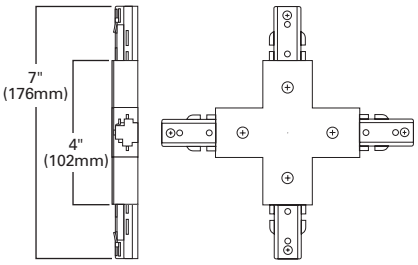
SAMPLE NUMBER: L905P

Connector	Finish
L905= T Connector	**P**=White **MB**=Black

L906 - X Connector

To connect four track sections into a cross configuration. May be used as feed point.

Color codes: P (White), MB (Black)



L906

ORDERING INFORMATION

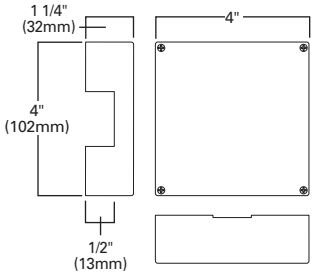
SAMPLE NUMBER: L906P

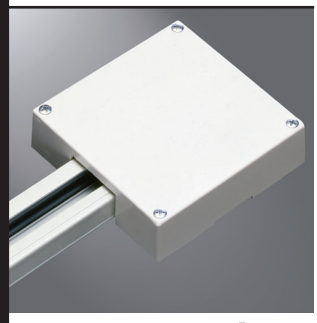
Connector	Finish
L906= X Connector	**P**=White **MB**=Black

L907 - Outlet Box for use with T-Bar Ceiling

L901, L903, L904, L905 or L906 connector also required. 4″x 4″ x 1 1/8″.

Color codes: P (White), MB (Black)





L907

ORDERING INFORMATION

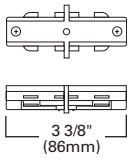
SAMPLE NUMBER: L907P

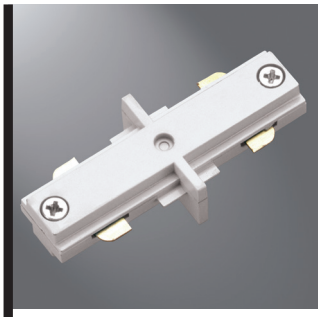
Connector	Finish
L907= Outlet Box for use with T-Bar Ceiling	**P**=White **MB**=Black

L908 - Mini Joiner

A low profile connector to cleanly and crisply join two straight track sections end-to-end. (Note: The L908 is not a feed point).

Color codes: P (White), MB (Black)





L908

ORDERING INFORMATION

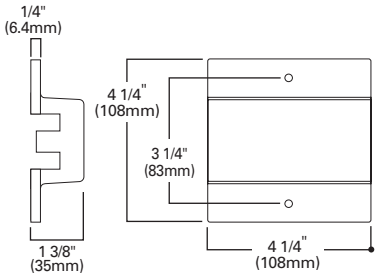
SAMPLE NUMBER: L908P

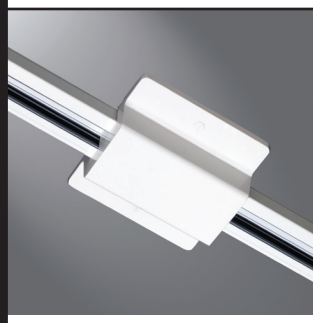
Connector	Finish
L908= Mini Joiner	**P**=White **MB**=Black

L909 - Floating Canopy and Connector

Track can be connected to existing outlet box located anywhere along the track. Comes with canopy cover, connector, dead-end and mounting hardware.
4 1/8" x 4 1/4" x 1 3/8".

Color codes: P (White), MB (Black)





L909

ORDERING INFORMATION

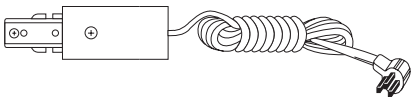
SAMPLE NUMBER: L909P

Connector	Finish
L909= Floating Canopy and Connector	**P**=White **MB**=Black

L950 - Cord and Plug Connector

12' three-wire cord with grounded plug. Maximum capacity 10 AMP.

Color codes: P (White), MB (Black)



L950

ORDERING INFORMATION

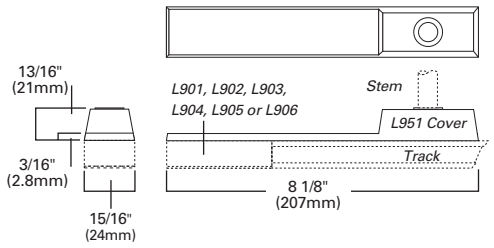
SAMPLE NUMBER: L950P

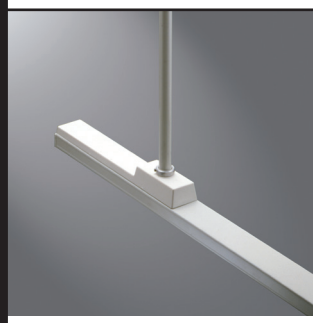
Connector	Finish
L950= Cord and Plub Connector	**P**=White **MB**=Black

L951 - Wire Way Cover for Pendant Assembly Kit

For track to be wired through stem(order one for each feed point used). For use with line connectors (L901, L902, L903, L904, L905 or L906) and pendant stem kit (L992)–order separately.

Color codes: P (White), MB (Black)





L951

ORDERING INFORMATION

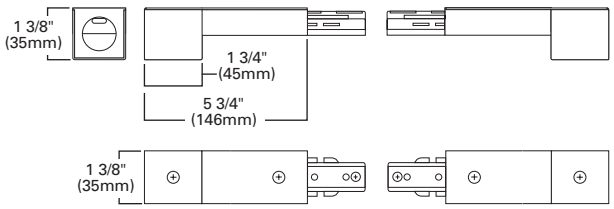
SAMPLE NUMBER: L951P

Connector	Finish
L951= Wire Way Cover for Pendant Assembly Kit	**P**=White **MB**=Black

L979 - Conduit Continuation Kit

Consisting of one left feed and one right feed. To continue a run around obstructions. Designed to accept 1/2" trade size conduit fitting (not included).

Color codes: P (White), MB (Black)



L979

ORDERING INFORMATION

SAMPLE NUMBER: L979P

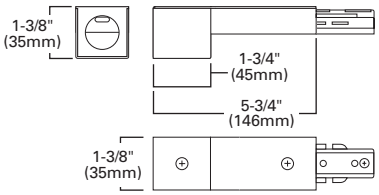
Connector	Finish
L979= Conduit Continuation Kit	**P**=White **MB**=Black

COOPER Lighting Solutions

L980 - Live End Conduit Adapter

Designed to accept standard 1/2" trade size conduit fitting (not supplied). Use when feeding to track through surface conduit system.

Color codes: P (White), MB (Black)



L980

ORDERING INFORMATION

SAMPLE NUMBER: L980P

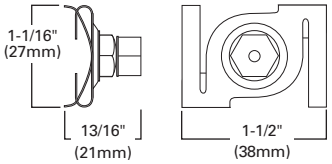
Connector	Finish
L980= Live End Conduit Adapter	**P**=White **MB**=Black

L983 - T-Bar Attachment Clip

Allows track to be attached to inverted tee ceiling. Order as follows: 2 kits for 2' Trac; 2 kits for 4' Trac; 3 kits for 8' Trac and 4 kits for 12' Trac.

L986 Mini-T Bar Clip

For mounting Trac on suspended ceilings with mini-grid (9/16" wide) system.



L983

ORDERING INFORMATION

SAMPLE NUMBER: L983P

Connector	Finish
L983= T-Bar Attachment Clip **L986**= Mini T-Bar Clip	**P**=White **MB**=Black

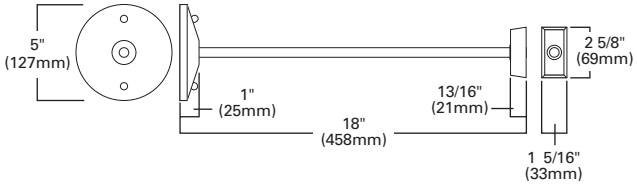
L992 - Pendant Kit Assembly

Order 2 kits for 2' Trac; 2 kits for 4' Trac; 3 kits for 8' Trac; and 4 kits for 12' Trac. Includes one 18" threaded steel stem, canopy andmounting hardware.

L48 48" Steel Stem

For additional length with L992. Can be field cut.

Color codes: P (White), MB (Black)



L992

ORDERING INFORMATION

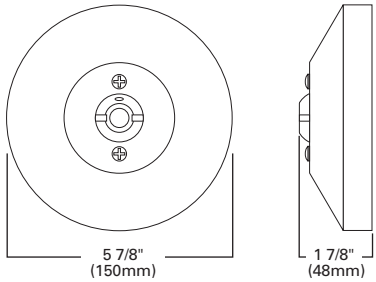
SAMPLE NUMBER: L992P

Connector	Finish
L992= Pendant Kit Assembly	**P**=White **MB**=Black

L994 - Pendant Adapter

For installing pendant mounted Power-Trac on sloped ceiling. For use with L992.

Color codes: P (White), MB (Black)



L994

ORDERING INFORMATION

SAMPLE NUMBER: L994P

Connector	Finish
L994= Pendant Adapter	**P**=White **MB**=Black

DE600 - Dead End

Color codes: P (White), MB (Black)

DE600

ORDERING INFORMATION

SAMPLE NUMBER: DE600P

Connector	Finish
DE600= Dead End	**P**=White **MB**=Black

Project		Catalog #		Type	
Prepared by		Notes		Date	

Lumière

EON 303-W1-LEDB2

Ceiling / Wall Mount
Direct / Indirect

Typical Applications

• Hospitality • Commerical Landscape • Outdoor Area/Site • Residential
• Architectural

Interactive Menu

- Order Information page 2
- Product Specifications page 2
- Lumen Maintenance page 3
- Product Warranty

Product Certification

CERTIFIED · RoHS COMPLIANT · IP66 · BAA

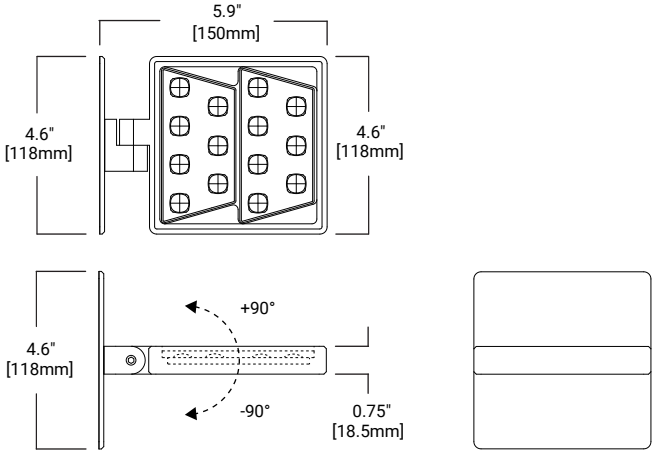
Product Features

wet location

Top Product Features

- Adjustable direct or indirect luminaire - 180° Adjustable at knuckle
- 2700K, 3000K or 3500K or 4000K Color Temperature and Amber (585-595nm)
- Forward/Lateral Throw or Flood Optics with diffuse glass sealed lens
- Patented AccuLED OpticsTM System
- Universal Input LED Driver Included (120 - 277V, 50/60 Hz)
- ELV or 0-10 Dimming

Dimensions



TECHNICAL DATA
50°C Maximum Temperature Rating
External Supply Wiring 90°C Minimum

Order Information

SAMPLE ORDER NUMBER: **303-W1-LEDB2-2700-UNV-T2-DIM10-BK-EDGE-LCF**

Domestic Preferences	Series	Color Temperature	Input Voltage	Optics	Dimming	Finish	Options
[Blank]=Standard **BAA**=Buy American Act	**303-W1-LEDB2**= Head contains two (2) Mini LightBAR™	**2700K**=2700K **3000K**=3000K **3500K**=3500K **4000K**=4000K **TSAM**=Turtle Safe Amber (585-595nm)	**UNV**=Universal 120-277, 50/60Hz	**T2**=Type II, Lateral Throw **T4**=Type IV, Forward Throw **T5X**=Type V, Extra Wide Flood	**DIMELV**=Trailing Edge Phase **DIM10**=0-10V Dimming	**Painted** **BK**=Black **BZ**=Bronze **CS**=City Silver **WT**=White	**EDGE**=Edge lit glass lens **LCF**=LightBAR cover plate matches housing finish
Notes (4) Only product configurations with this designated prefix are built to be compliant with the Buy American Act of 1933 (BAA). Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.	**Notes**	**Notes**	**Notes**	**Notes**	**Notes**	**Notes** (1) Custom and RAL color matching available upon request. Consult factory for further information. (4) Consult factory for premium / natural metals material finish.	**Notes** (2) Add suffix in the order shown. (3) LCF option not available when WT (white) finish is selected.

Product Specifications

Construction

- Head and back plate are precision machined from corrosion-resistant 6061-T6 aluminum
- A universal mounting plate and one piece silicone key hole gasket is provided for adaption to junction box or surface
- Stainless steel hardware is included

Mounting

- The luminaire mounts directly to a standard 4" square junction box
- For further mounting information see technical notes section on page 3

Optical

- LightBAR and optical assembly are sealed by a diffused, impact resistant tempered glass lens
- The optical assembly is available in three distributions: T2 (lateral throw), T4 (forward throw) and T5X (Extra Wide Flood)
- Available in several color temperatures: 2700K, 3000K, 3500K, 4000K and TSAM (Amber)
- Both color temperature and distribution must be specified when ordering – see catalog logic for details
- An edge-lit option is available

Electrical

- The 15.5W 303-W1-LEDB2 is standard with an ELV trailing edge phase dimmable driver that accepts a universal input (120-277, 50/60Hz)
- It will operate in -40°C to 50°C [-40°F to 122°F]
- The driver incorporates surge protection
- An optional 0-10V dimming driver is also available.

Finish

- The luminaires are double protected by a RoHS compliant chemical film undercoating and polyester powder coat paint finish, surpassing the rigorous demands of the outdoor environment
- A variety of standard colors are available
- RAL and custom color matches available upon request
- Luminaries can also be brushed with a clear coat finish
- The LightBAR cover plates are standard white and may be specified to match finish of luminaire housing (LCF)

Approvals

- UL and cUL listed, standard wet label
- Tested according to IESNA LM-79 and LM-80 procedures
- ROHS Compliant
- IP66 Ingressed Protection rated

Warranty

- Lumiere warrants the EON series of fixtures against defects in material and workmanship for five (5) years. Auxiliary equipment such as LED drivers carries the original manufacturer's warranty

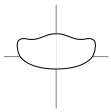
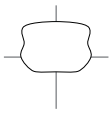
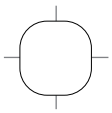
Lumen Maintenance

Ambient Temperature	TM-21 Lumen Maintenance (72,000 Hours)	TM-21 Reported L70(10k) (Hours)	Theoretical L70 (Hours)
25°C	> 94%	> 60,000	365,000
40°C			
50°C			

Current Draw

Model	Line Voltage	Current Draw
303-W1-LEDB2	120-277V, 50/60Hz	0.13A

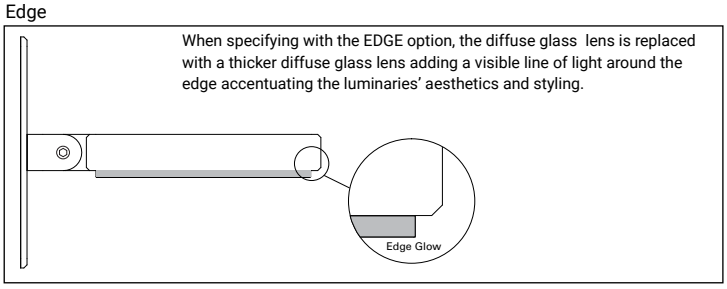
Lumens - CRI/CCT Table

Optic Type	Distribution	Watts	Delivered Lumens	LPW	CCT (K) / Color	CRI nom. / Wavelength
T2 (Lateral Throw)		15.5	1052	68	2700	90
			1082	70	3000	80
			1177	76	3500	80
			1151	74	4000	80
		12.1	351	29	TSAM	585-595nm
T4 (Forward Throw)		15.5	961	62	2700	90
			989	64	3000	80
			1075	69	3500	80
			1052	68	4000	80
		12.1	329	27	TSAM	585-595nm
T5X (Extra Wide Flood)		15.5	1174	76	2700	90
			1208	78	3000	80
			1313	85	3500	80
			1285	83	4000	80
		12.1	396	33	TSAM	585-595nm

NOTES: 1 When the LCF option is selected use a lumen multiplier of .85

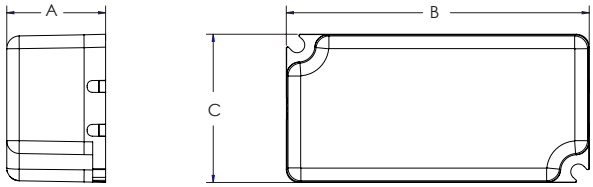
Options

Edge



Technical Notes

1. Junction box size and depth is important when specifying product. Recommended junction boxes include 2-1/8" deep, 4" square weld/drawn Crouse Hinds part numbers TP403, TP434, TP494, TP196, TP395 or equivalent. Use with included universal mounting plate or with Crouse-Hinds part number TP480 or equivalent cover with similar fixture mounting locations.
2. The universal wall plate provided with all EON wall mount fixtures can be used with an outdoor rated two gang 30.5 cubic inch capacity outlet box. Cooper Crouse-Hinds part numbers TP7086 – TP7122 or equivalent. The universal mounting plate will attach with four (4) 6-32 pan head/flat stainless steel screws (not provided).
3. Driver can be remote mounted in a junction box a max distance of 25 feet (voltage drop needs to be considered) or placed in the junction box behind the luminaire.
4. When specifying with the EDGE option, the diffused glass becomes thicker adding a visible line of light around the edge accentuating the luminaries' aesthetics and styling.
5. If Luminaire will not be dimmed, the Luminaire must be ordered with DIMELV option, but does not have to be dimmed.
6. Driver Dimensions:



Luminaire Type	Dimming Type	Driver Dimensions in [mm]		
		A	B	C
303-W1-LEDB2	DIMELV	.98 [25.0]	3.36 [85.3]	1.49 [37.9]
	DIM10	1.18 [30.0]	3.49 [88.6]	1.64 [41.6]

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Specifications and dimensions subject to change without notice.

SECTION 26 56 13

LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Poles and accessories for support of luminaires.
2. Luminaire-lowering devices.

1.2 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete luminaire.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: For <Insert equipment,> accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For **poles and luminaire-lowering devices** to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

B. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inchdeep. Do not apply tools to section of pole to be installed below finished grade.

C. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.

D. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) and luminaire-lowering device(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: FIVE years from date of Substantial Completion.
2. Warranty Period for Corrosion Resistance: FIVE years from date of Substantial Completion.
3. Warranty Period for Color Retention: FIVE years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. Component Importance Factor: 1.0.

B. Structural Characteristics: Comply with AASHTO LTS-6-M.

C. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.

D. Live Load: Single load of 500 lbf (2200 N) distributed according to AASHTO LTS-6-M.

E. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

F. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

1. Basic wind speed for calculating wind load for poles exceeding 50 feet (15 m) in height is [100 mph (45 m/s)] [90 mph (40 m/s)] <Insert value from AASHTO LTS-6-M for this Project>.

    a. Wind Importance Factor: [1.0] <Insert value from AASHTO LTS-6-M>.
    b. Minimum Design Life: [50 years] <Insert value from AASHTO LTS-6-M>.
    c. Velocity Conversion Factor: [1.0] <Insert value from AASHTO LTS-6-M>.

2. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is [100 mph (45 m/s)] [90 mph (40 m/s)] <Insert value from AASHTO LTS-6-M for this Project>.

    a. Wind Importance Factor: [1.0] <Insert value from AASHTO LTS-6-M>.
    b. Minimum Design Life: [25 years] <Insert value from AASHTO LTS-6-M>.
    c. Velocity Conversion Factor: [1.0] <Insert value from AASHTO LTS-6-M>.

G. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of [1.1] <Insert number> to obtain the EPA to be used in pole selection strength analysis.

H. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 METALLIC POLES

A. Provide poles made of steel or aluminum, round or square, tapered or straight, as described on plans.

B. Source Limitations: Obtain poles from single manufacturer or producer.

C. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

D. Steel Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig. Where designated as stainless steel, comply with ASTM A 240/A 240M with a minimum yield of 55,000 psig. One-piece construction up to 40 feet in height with access handhole in pole wall.
1. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

E. Aluminum Poles: Seamless, extruded structural tube complying with ASTM B 221, Alloy 6063-T6, with access handhole in pole wall.
1. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

F. Mast Arms: Provide quantity of arms as described in plans, continuously welded to pole attachment plate. Material and finish same as pole.

G. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

H. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

I. Fasteners: Stainless or Galvanized steel type, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

J. Grounding and Bonding Lugs: Welded 1/2-inchthreaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

K. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

L. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.

M. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

N. Galvanized Finish Steel: After fabrication, hot-dip galvanize according to ASTM A 123/A 123M.

O. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
   1. Color: As selected by Architect from manufacturer's full range.

P. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
   1. Color: As selected by Architect from manufacturer's full range.

2.3 FIBERGLASS POLES

A. Poles:

   1. Designed specifically for supporting luminaires, with factory-formed cable entrance and handhole.
   2. Not less than 65 percent by weight of fiberglass roving, with resin and pigment making up the remainder.
   3. Roving shall be continuously applied with uniform tension, with multiple layers placed to meet axial and compressive strength requirements.
   4. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
   5. Resin Color: As selected by architect; uniform coloration throughout entire wall thickness.
   6. Surface Finish: Smooth and uniform along surface of pole.

A. Mast Arms: Provide quantity of arms as described in plans, continuously welded to pole attachment plate. Material and finish same as pole.

B. Brackets for Luminaires: Detachable, cantilever, without underbrace.

   1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together.
   2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

C. Pole-Top Tenons: Steel, hot-dip galvanized according to ASTM A 153, or 6061-T6 aluminum, permanently bonded to the fiberglass shaft. Fabricated to support luminaire or luminaires and brackets indicated.

D. Fasteners: Stainless or Galvanized steel type, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

   1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
   2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

E. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

F. Grounding: Bare, stranded copper, #6 AWG, suspended inside of pole, connected to luminaire(s), ground lug near handhole and ground rod.

G. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

H. Anchor Base: Integral galvanized steel or aluminum casting, enclosing and permanently bonded to the exterior of the fiberglass shaft.

2.4 WOOD POLES

A. Poles: **Douglas fir, Southern yellow pine**, machine trimmed by turning, for wood species used; and bored, roofed, and grained before treatment.

1. Pole Brand: Brand the manufacturer's trademark and date of treatment, height and class of pole, wood species, preservation code, and retention. Brand shall be placed so that the bottom of the brand is minimum 10 feet (3 m) from pole butt.
2. Mounting Provisions: Embedded.

B. Fasteners: Galvanized steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

C. Preservative Treatment: Treat according to [AWPA UC4A] [AWPA UC4B] [AWPA UC4C].

D. Luminaire Brackets: Comply with ANSI C136.13.

2.5 PRESTRESSED CONCRETE POLES

A. Poles: Comply with ASTM C 1089.
1. Mounting Provisions: **Steel butt flange for bolted mounting to foundation or breakaway support, Embedded.**
2. Finishing: Capped at top and plugged at bottom. Seat each reinforcing strand with epoxy adhesive.
3. Grounding: Continuous copper ground wire cast into pole. Terminate at top of pole.
4. Raceway: Smooth, internal, and not less than 3 inches (76 mm) in diameter.

B. Concrete: Minimum 28-day compressive strength of 7000 psi (48,265 kPa) .

C. Cured with wet steam and aged for a minimum of 15 days prior to installation.

D. Surface Treatment: Hard, nonporous, and resistant to water, frost, and road and soil chemicals; and shall have a maximum water-absorption rate of 3 percent.

E. Fasteners: Galvanized steel, size and type as determined by manufacturer. Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.

F. Nameplate: Aluminum cast into pole wall at approximately 5 feet (1.5 m) above ground line, listing name of manufacturer, Project identifier, overall height, and approximate weight.

G. Pole Brackets: Comply with ANSI C136.31.

2.6 POLE ACCESSORIES

A. Duplex Receptacle: Ground-fault circuit interrupter type, 120 V ac, 20 A in a weatherproof assembly. Comply with requirements in Section 262726 "Wiring Devices."

B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.

C. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

D. Transformer-Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and to accept ballast(s) or indicated accessories. Include removable flanged access cover secured with bolts or screws.

E. Decorative accessories, supplied by decorative pole manufacturer, include the following:

1. Banner Arms, Flag Holders, Finials, Flower Pot Hooks.

2.7 LOWERING SYSTEM FOR LUMINAIRES

A. System Description: Capable of lowering luminaire [**assembly**] to a service position within 36 inches of finished grade in winds up to 30 mph. Provide manual plug connection to electrical power accessible in lowered position. Assembled system of pole, luminaire, and lowering device shall be capable of loads specified in "Performance Requirements" Article.

B. Compatibility of Material: Materials for attachment and connection of luminaire-mounting assembly, lowering device, lowering cable, and portable winch shall be compatible to avoid corrosion and electrolysis.

C. Structural and Mechanical Design Safety Factor: 5.0, minimum, for static and dynamic loads of load-bearing components, including cable.

D. Luminaire-Mounting and Disconnect Arrangement: Multiple [**ring**] [**carriage**]-mounted luminaires, arranged for lowering and rising as a group.

1. Electrical cable for normal operating power to luminaires shall manually disconnect inside pole base, using weatherproof multi-pin connector, and shall be arranged to move within the pole during lowering and rising of luminaire assembly.
2. Electrical cable for normal operating power to luminaires shall automatically disconnect at weatherproof multi-pin connector within the pole-top lowering head at the beginning of the lowering cycle and reconnect when luminaire or luminaire assembly is raised to the operating position.

E. Lowering Device: Weatherproof, cast-aluminum housing, and multiple mechanical latches. Moving parts of latching assembly shall be located in the portion of the unit that is lowered to servicing position. Positive latching in the operating position shall be indicated to the operator at the base of the pole by a clear visual signal or by other means acceptable to Owner or authorities having jurisdiction.

F. Lowering Cable: [Zinc-electroplated-] [or] [stainless-] steel aircraft cable.

G. Portable Winch: [**Manual**] [**120-V electric**] type. [**One**] <**Insert number**> required.

1. Winch Power Connection: Cord and plug.
2. Winch Raise-Lower Control: Remote-control station with [**15 feet**] <**Insert dimension**> of cable.

2.8 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to [**ASTM F 1554, Grade 55,**] with a minimum yield strength of 55,000 psi.

1. Galvanizing: [**Hot dip galvanized according to ASTM A 153, Class C**] [**Mechanically deposited galvanization according to ASTM B 695, Class 50**].
2. [**Bent**] [**Headed**] rods <**Insert inches**> in diameter by <**Insert inches**> in length.
3. Threading: [**Uniform National Coarse**] [**Uniform National 8**], Class 2A.

B. Nuts: ASTM A 563, Grade A, Heavy-Hex

1. Galvanizing: [**Hot dip galvanized according to ASTM A 153, Class C**] [**Mechanically deposited galvanization according to ASTM B 695, Class 50**].
2. [**Two**] [**Four**] <**Insert number**> nuts provided per anchor bolt [**, shipped with nuts pre-assembled to the anchor bolts**].

C. Washers: ASTM F 436, Type 1.

1. Galvanizing: [**Hot dip galvanized according to ASTM A 153, Class C**] [**Mechanically deposited galvanization according to ASTM B 695, Class 50**].
2. [**One**] [**Two**] <**Insert number**> washers provided per anchor bolt.

2.9 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine poles, luminaire-mounting devices, **lowering devices**, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

B. Examine roughing-in for foundation and conduit to verify actual locations of installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

C. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories.

1. Baseplate: Stamped with manufacturer's name, date of production, and cable entry.

D. Direct-Buried Foundations: Install to depth indicated on Drawings, but not less than one-sixth of pole height. Add backfill in 6-inch to 9-inch layers, tamping each layer before adding the next. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.

E. Direct-Buried Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.

1. Make holes 6 inches in diameter larger than pole diameter.
2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days and finish in a dome above finished grade.
3. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
4. Cure concrete a minimum of 72 hours before performing work on pole.

F. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.3 POLE INSTALLATION

A. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.

1. Fire Hydrants and Water Piping: 60 inches .
2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet .
3. Trees: 15 feet from tree trunk.

B. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
2. Install base covers unless otherwise indicated.
3. Use a short piece of 1/2 -inch (13-mm) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

D. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Special Inspections: **Owner will engage**, **Engage** a qualified special inspector to perform the following special inspections:

1. Inspect poles for nicks, mars, dents, scratches, and other damage.
2. System function tests.

END OF SECTION 26 56 13

SECTION 26 56 19

LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for LED luminaires indicated in the Luminaire Schedule on the drawings.

B. Luminaire supports.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests IES LM-79 and IES LM-80.
    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
7. LED driver or power supply product data sheets for each luminaire.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.
4. Where specifically indicated on plans, include photometric PxP drawings for areas where alternate fixtures are supplied.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing laboratory providing photometric data for luminaires.

B. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each type of luminaire.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. One (1) copy of each approved submittal.

2. Certificate of Material Receipt.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Drivers: TEN percent of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: ONE percent of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: ONE percent of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Provide luminaires from a single manufacturer for each luminaire type.

B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

C. Mockups: For exterior luminaires, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: FIVE year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

A. Refer to Luminaire Schedule on drawings for Luminaire types and construction requirements.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

E. UL Compliance: Comply with UL 1598 and listed for wet location.

F. LED lamps and driver shall have a rated life of minimum 50,000 hours.

G. LED driver shall meet ANSI C62.41 Category. A surge protection standard up to 4 kV.

H. CRI of minimum 80. CCT of 4000K unless otherwise noted.

I. Ambient Temperature: LED Luminaire shall be rated from 5 deg F to +104 deg F.

J. In-line Fusing: Separate in-line fuse for each luminaire.

K. LED Lamp Module Rating: Lamp marked for outdoor use.

L. Source Limitations: Obtain luminaires from single source from a single manufacturer.

M. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRE TYPES

A. Provide types as indicated in Luminaire Schedule and as indicated on drawings.

2.5 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Metal Components: As indicated in Luminaire Schedule. Form and support to prevent warping and sagging.

C. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

2.6 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Finish Color: Unless otherwise noted, color shall be selected by the architect. Provide color chip samples or selection sheet with shop drawings.

2.7 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Fasten luminaire to structural support.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Where recommended by luminaire manufacturer, attach to structural members in walls. Otherwise mount fixture to back box.

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Coordinate layout and installation of luminaires with other construction.

H. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 BOLLARD LUMINAIRE INSTALLATION:

A. Align units for optimum directional alignment of light distribution.

1. Install on concrete base. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Refer to details on drawings for mounting orientation and requirements.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

   a. IES LM-5.
   b. IES LM-50.
   c. IES LM-52.
   d. IES LM-64.
   e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

A. **Engage a factory-authorized service representative to train**, **Train** Owner's maintenance personnel to adjust, operate, and maintain luminaires and any photocell relays.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within the warranty period, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to TWO visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace LED module, driver or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 56 19

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SECTION 27 00 01

GENERAL REQUIREMENTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 DEFINITIONS

A. Acceptance Testing Authorities (ATA) - The individuals and/or business entities that participate in Acceptance Testing and report to the Owner when work appears to be compete. These parties represent the interest of the Owner.

B. Authority Having Jurisdiction (AHJ) - The governmental agency or sub-agency having authority over the construction process and having the ultimate authority to enforce, uphold and rule on codes and safety compliance at the project site.

C. Contractor – The entity(s) contractually responsible for performing work of this Division.

D. Wherever the words “Site”, “Project Site”, or “Premises” appears in these specifications or related drawings, it shall be interpreted to mean all real estate, buildings and structures where work will be performed and where products will be installed and reside.

E. Commissioning Authority – An agent of the Owner, often independent of the design team, responsible for ensuring compliance with the Owner’s project intent.

F. Contractor of Record – The Contractor entering into a contract for all or part of the work of this division directly with the Owner, directly with the Construction Manager or directly with a General Contractor.

G. Designer – The Consultant(s) representing the Owner and directly responsible for specification of work within this Division including their related drawings. The Designer may or may not be affiliated with the architectural or an engineering firm of record for this Project. The Designer is a member of the project Design Team.

H. Furnish – To supply product or labor (context dependant) including all associated shipping, storage, travel, lodging, miscellaneous and warranty expenses.

I. High Voltage – For the sake of this division, greater than 70.7VAC RMS; greater than or equal to 100VAC P-P; greater than 70.7VDC

J. Install – To supply all labor, tools and incidental materials necessary to handle, store, mount, terminate, program, configure and adjust a product in order to fulfill the requirements of this project.

K. Low Voltage – For the sake of this division, less than or equal to 70.7VAC RMS; less than 100VAC P-P; less than or equal to 70.7VDC

L. Medium Voltage – For the sake of this division, greater than 70.7VAC RMS; greater than or equal to 100VAC P-P; greater than 70.7VDC.

M. Nominal Operating Level: The standard signal voltage/power reference which a manufacturer has designed its product’s inputs and outputs to operate at in order to achieve specified performance.

N. Provide – To furnish and install, inclusive of accessories, modules, and ancillary items necessary to render the respective product and system fully operational and usable to the Owner for its intended purpose.

O. Substantial Completion
1. The point in this project where all work of this Division that occurs at the project site has been completed. For work to be substantially complete, all of the following must be valid:
   a. All products have been delivered and installed at the project site, and;
   b. All portable and loose equipment has been delivered, and;
   c. All systems have been installed, adjusted and are usable by the owner for their intended purpose, and;
   d. All products, including cables, have been labeled in accordance with these specifications and related drawings, and;
   e. All systems are performing in accordance the design intent of these specifications, drawings and reference standards, and;
   f. All systems have been demonstrated as complete and working to the
   g. Designer, and;
   h. All systems have been demonstrated as complete and working to Owner, and;
   i. The Contractor has successfully completed Acceptance Testing of all work of all sections.
   j. The Contractor has complied with all additional requirements of the
   k. Contract.

P. Work – The supply of products, materials, labor, incidentals and services necessary to fulfill the complete requirements of this project.

Q. Acronyms and Abbreviations
1. ADA - Americans with Disabilities Act
2. AM – Amplitude Modulation
3. ANSI – American National Standards Institute
4. ASME - American Society of Mechanical Engineers
5. ASTM – American Society of Testing Materials
6. ATM – Asynchronous Transfer Mode
7. AWG – American Wire Gauge
8. BGP – Border (Boundary) Gateway Protocol
9. BICSI - Building Industry Consulting Services International
10. BIT – Binary digit
11. BOM – Bill of Material
12. Bps – Bits per second
13. BRI – Basic Rate Interface
14. CAD – Computer Aided Design
15. CAN – Campus Area Network
16. CATV – Community Antenna Television
17. CCITT – Consultative Committee for International Telegraphy and Telephony
18. CCTV – Closed Circuit Television
19. CDDI – Copper Distributed Data Interface
20. CLEC – Competitive Local Exchange Carrier
21. CPE – Customer Premises Equipment
22. CPU – Central Processing Unit
23. CSA – Canadian Standards Associations
24. CSMA/CA – Carrier-Sense Multiple Access with Collision Avoidance
25. CSMA/CD – Carrier-Sense Multiple Access/Collision Detection
26. CSU – Channel Service Unit
27. db - Decibel
28. Device ID – A system specific label assigned to a product to uniquely identify it within a given a system.
29. DSL – Digital Subscriber Line
30. DSU – Data Service Unit/Digital Service Unit
31. DTE – Data Terminal Equipment
32. EF – Entrance Facility
33. EGP – Exterior Gateway Protocol

34. EIA – Electronics Industries Association
35. EMI – Electromagnetic Interface
36. ER – Equipment Room
37. ETSI – European Telecommunications Standards Institute
38. FCC – Federal Communications Commission
39. FDDI – Fiber Data Distributed Interface
40. GAN – Global Area Network
41. GB – Giga Byte
42. Gb/s (Gbps) – Gigabits per second
43. GHz – Gigahertz
44. IDF – Intermediate Distribution Frame (Replaced by TR)
45. IEEE – Institute of Electrical and Electronics Engineers
46. IP – Internet Protocol
47. IPX – Internet Packet Exchange
48. ISDN – Integrated Services Digital Network
49. ISO – International Organization for Standardization
50. ISP – Internet Service Provider
51. LAN – Local Area Network
52. LANE – LAN Emulation
53. LASER – Light Amplification by Stimulated Emission of Radiation
54. LAT – Local Area Transport
55. LATA – Local Access and Transport Area
56. LEC – Local Exchange Carrier
57. LED – Light Emitting Diode
58. MAC – Media Access Control
59. MAN – Metropolitan Area Network
60. MB – Mega Bytes
61. Mb/s (Mbps) – Megabits per second
62. MDF – Main Distribution Frame (Replace by ER)
63. MHz – Megahertz
64. MODEM – Modulator/Demodulator
65. ms – millisecond
66. MTBF – Mean Time Between Failures
67. MPLS – Multi Protocol Label Switching
68. OC – Optical Carrier
69. OFCI – Owner Furnished Contractor Installed
70. OFE – Owner Furnished Equipment
71. OFOI – Owner Furnished Owner Installed
72. OSI – Open Systems Interconnection
73. PAN – Personal Area Network
74. pps – Packets Per Second
75. PRI – Primary Rate Interface
76. PSTN – Public Switched Telephone Network
77. QoS – Quality of Service
78. RAID – Random Array of Inexpensive Disks
79. RAM – Random Access Memory
80. RBOC – Regional Bell Operating Company
81. RF – Radio Frequency
82. RFC – Request For Comment
83. RFI – Request For Information/ Radio Frequency Interference
84. RFP – Request For Proposal
85. RFQ – Request For Quotation
86. RIP – Routing Information Protocol
87. RMON – Remote Monitor
88. ROM – Read Only Memory
89. SMTP – Simple Main Transfer Protocol
90. SNA – Systems Network Architecture
91. SNMP – Simple Network Management Protocol
92. SONET – Synchronous Optical Network
93. TB – Tera Byte
94. TCP – Transmission Control Protocol

95. TCP/IP – Transmission Control Protocol/Internet Protocol
96. TIA – Telecommunications Industries Association
97. TR – Telecommunications Room
98. VoIP – Voice over Internet Protocol
99. WAN – Wide Area Network

1.2 QUALITY ASSURANCE

A. The Contractor shall have a business history of at least (5) years performing Work of similar type as that specified in these project documents. In addition, the Contractor shall also be able to demonstrate through valid references and other Designer required support information that it has successfully completed no less then (6) projects of similar or greater contract value, with like system types, and including similar scope of work within the last 24 calendar months. This applies to each section of work individually.

B. Contractor shall be a "factory-authorized" reseller (distributor, dealer, integration partner and/or channel partner) for at least 70% of the product value to be supplied.

C. Contractor shall have substantial business operations located within a (300)-mile radius of the project site with full-time employee staff actively engaged in the supply, installation and service of systems and equipment of the type and scope herein specified.

D. Contractor shall have full-time employee service staff based within a (50)-mile radius of the project site.

E. Contractor shall supply any additional information requested by the Designer deemed appropriate by the Designer to validate the Contractor's qualifications and its ability to perform and warranty the specified work within the time frame allotted and of the quality expected.

F. Contractor shall provide the services of locally licensed and authorized electrician(s) to perform that portion of the work of this division that is required by the applicable codes and/or the AHJ to be performed by licensed electrician(s).

G. Superintendent/Project Manager
   1. The Contractor shall furnish the services of an experienced superintendent/Project Manager who shall be constantly in charge of the work, together with a qualified Foreman and technical specialists to properly install, connect, adjust, start, operate and test the work involved.
   2. The superintendent's/Project Manager's qualifications shall be subject to the review and acceptance by the Designer and Owner. Unless the Designer and Owner grants prior special permission, the same Superintendent/Project Manager shall be utilized throughout the duration of the project and shall remain responsible for the complete scope of the Contract.

H. Subcontractors
   1. If the Contractor, as a singular entity, does not meet 100% of the quality assurance requirements for all specification sections, the Contractor shall enlist the services of qualified subcontractors to perform the work of those section(s) for which Contractor is not fully qualified. This includes but is not limited to the supply of the products for the section but also the supply of the project engineering services, preparation of shop drawings and section submittals, technical installation labor, training, warranty, post installation support and service.
   2. The Contractor shall ensure that each Subcontractor supplies the services of a project manager to represent the interest of the Subcontractor at all project meetings in which the Contractor is also required to participate. This requirement is mandatory as an aid towards ensuring that the special needs and timing of subcontracted work are fully represented to the project team.
   3. The Designer and Owner reserve the right to disqualify the use of any subcontractor that does not meet the quality assurance requirements set forth in these specifications. Should a subcontractor be disqualified, the Contractor shall supply the services of a different subcontractor that complies with the published quality assurance requirements. The Contractor is solely

responsible for costs incurred as a result. It is therefore incumbent upon the Contractor to pre-qualify subcontractor choice(s) prior to submitting pricing for work.

4. For the purposes of achieving quality assurance compliance, an equipment vendor that is not performing the technical installation labor associated with work of a section shall not be considered a subcontractor

I. Trainer Qualifications

1. Individual(s) conducting training shall be fully knowledgeable of the product, system and technology on which they will be training. These individuals shall be factory trained, factory certified and/or otherwise approved by the Designer as having sufficient experience and knowledge in the area of interest to conduct training.

1.3 SUBMITTALS

A. Refer to Section 26 00 15 “Submittals”.

1.4 WARRANTY

A. Unless otherwise noted, all materials and workmanship furnished shall be covered by the Contractor for a minimum period of (1) year from date of Acceptance Testing Completion or Substantial Completion (whichever is later) for related work.

1. Supplied products with manufacturer’s warranties of less than the warranty term shall be extended by the Contractor for the full specified warranty term.
2. Supplied products featuring a standard manufacturer’s warranty whose term extends beyond the Contract Warranty term shall be shall be facilitated by the Contractor for the full duration and conditions of the manufacturer’s warranty.

B. The Warranty supplied shall be a full “System Warranty” that covers all supplied products, onsite and off-site labor and related personnel transportation and product shipping expenses.

1. During this period the Contractor will remedy (at no cost to the Owner) any problem with the system, or any of its related components that is the result of defective materials, equipment settings, workmanship, or loss of programming.

C. Individual sections of this Division may feature more stringent requirements than those set forth in this section. The most stringent of these requirements shall apply.

D. All warranty work shall be performed at the Contractor’s expense and to the satisfaction of the Owner and Designer.

E. Response Requirements

1. During the Warranty Period, the Contractor shall:
   a. Respond by phone within four (4) business hours of notice by the Owner of a problem, and;
   b. Supply qualified personnel onsite within (1) business day or (72) contiguous hours (which ever comes first) to begin remediation of the problem, if the problem cannot be remediated over the phone in less time, and;
   c. Supply “on-call” emergency response service labor (at the request and authorization of the Owner) at a hourly rate that does not exceed the Contractor’s published emergency service rates, nor two-times the Contractor’s standard hourly rate, whichever is lower.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials, apparatus and equipment shall bear the Underwriter's Laboratory, Inc. label (or other nationally recognized testing laboratory label) where regularly supplied, and as additionally required by Code.

B. All products furnished shall be new, full weight and of the best quality. All similar materials shall be of the same type and from the same manufacturer.

C. In the event that a specified product is discontinued by the manufacturer and is no longer available for purchase, the Contractor shall provide replacement product of equal or greater value, performance and function as that of the Basis of Design product. The replacement product shall be from the same manufacturer as that of the Basis of Design equipment unless written permission has been granted by the Designer. The Contractor is solely responsible for researching and submitting proposed replacement product. The final decision as to whether a Contractor proposed replacement is acceptable lies solely with the Designer

D. Substitute products will only be considered provided that the Contractor has strictly adhered to the guidelines set forth by Division 1 Specifications.

PART 3 - EXECUTION

3.1 WORK AND WORKMANSHIP

A. Provide all required labor, materials, equipment and Contractor’s services necessary for complete installation of systems required to comply with the requirements of authorities having jurisdiction, as indicated on Drawings, and as specified.

B. Work shall be functional and complete in every detail, including any and all items required to complete the system, regardless of whether all items have been fully enumerated or shown on the Drawings.

C. Special attention shall be given to access to working and controlling parts. Adjustable parts shall be within easy reach. Removable parts shall have space for removal.

D. Contractor and Subcontractors shall be fully knowledgeable of the details of all Work to be performed by other trades and shall take necessary steps to integrate and coordinate Work of This Division with that of other Divisions and other trades.

E. Wherever tables or schedules show quantities, they shall not be interpreted to represent the total contract quantity requirement, but instead a portion of the contract requirement. The Contractor shall be responsible for the higher quantity communicated by the drawings, within the specifications and on the schedules/tables. Seek clarification from the Designer should a discrepancy between them be found.

F. The Designer and Owner’s Representative have the full power to condemn or reject any Work, materials or equipment not in accordance with these Specifications and Construction Drawings or the manufacturer’s specifications or drawings reviewed by the Designer or Owner.

G. Work or equipment that is rejected shall be removed and replaced to the satisfaction of the Owner at the Contractor’s expense. Work or equipment that is rejected shall be so stated in writing by the Owner or Designer.

H. Such decisions that the Owner or Designer may make with respect to questions concerning the quality, fitness of materials, equipment, and workmanship shall be binding upon the parties thereto.

I. Work shall fully comply with these specifications and related Drawings and all manufacturers recommended installation guidelines.

J. All Work shall be performed with the best practices of the trade for performance, functionality, safety, endurance, and aesthetics.

K. Coordinate ordering and installation of all equipment with long lead times or having a major impact on work by other trades so as not to delay the job or impact the schedule.

L. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible. Consult the Designer for direction.

M. Set all equipment to accurate line and grade, level all equipment and align all equipment components.

N. Supply scaffolding, rigging, hoisting and services necessary for erection and delivery of equipment and apparatus furnished into the premises. These items shall be removed from premises when no longer required.

O. Equipment shall not be hidden or covered up prior to inspection by the Owner's representative. Work that is determined unsatisfactory shall be corrected immediately.

P. Work shall be installed level and plumb, parallel and perpendicular to prevailing building lines, except as expressly detailed otherwise or required for proper form, function or Designer intended operation.

Q. Install equipment and materials in strict accordance with the manufacturer's written instructions. Bring conflicts between the manufacturer's written instructions and these project documents to the attention of the Designer for review and direction.

R. Upon completion of installation of equipment and communication circuitry, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with re-testing.

3.2 TESTING

A. General
1. Upon complete physical installation of products, the Contractor shall align, balance, and adjust equipment to make it usable to the Owner for its intended purpose, and to ensure compliance with all related drawings, specifications and references.
2. The Contractor shall fully test each system, and each component thereof, and correct all deficiencies prior to scheduling acceptance testing.
3. Replace malfunctioning or damaged products with new product, following immediately with retesting until satisfactory performance and specification compliant conditions are achieved.

B. Operational Testing
1. Perform operational testing of all supplied products, individually and collectively, to verify conformance with these project documents, and as required ensuring compliance with the product manufacturer's published specifications and as additionally necessary for the system to meet the intended purpose.
2. Perform operational testing of Owner furnished equipment to the extent necessary to verify overall system functionality and specification compliance. Report any compliance problems that are directly the result of Owner Furnished Equipment.
3. Although each system requires additional supplemental testing to confirm compliance, the following testing shall be conducted as they apply to the supplied systems products.
   a. Verify all functions of all supplied equipment as applicable to the design, functionality and intended use of the system.
   b. Test each system inputs and output.
   c. Test each remote control.
   d. Test each source device

e. Setup and test portable equipment.

C. Performance Testing
1. Perform all measurements and testing necessary to demonstrate performance compliance.

3.3 ACCEPTANCE TESTING

A. Acceptance Testing is conducted by the Designer and/or the Owner's designated Commissioning Authority and/or the Owner.

B. Acceptance testing occurs following the submittal and review of required Pre- Acceptance Submittal(s).

C. Acceptance testing may include, but may not necessarily be limited to:
1. Visual and mechanical inspections of Contractor's workmanship
2. Inventory of equipment
3. Random system and/or component measurements to verify compliance with specifications and to check of the accuracy of the Pre-Acceptance Submittal and as-built drawings
4. Inspection of system components, sub-systems, software, component functionality, etc…
5. Other tests and/or inspections as determined necessary by the Designer
6. Functional tests of system
7. Performance measurements of components or groups of components

D. The Contractor shall be onsite in advance of the scheduled acceptance testing time to get prepared for and stage for testing. Contractor shall schedule and coordinate acceptance testing with all parties. Contractor shall coordinate and ensuring free access into all areas of work.

E. The Contractor shall have qualified technical representation onsite to work with the Designer during Acceptance Testing. The representative(s) shall be fully familiar with aspects of the work being evaluated.

F. Prior to the start of Acceptance Testing the Contractor shall have turned over a copy of the most up-to-date as-built documentation.

G. The Contactor shall furnish and shall have present at the project site test equipment, cables, tools and personnel necessary to test, verify and demonstrate any product, operation, and workmanship deemed necessary by the Designer.

H. The Contractor shall be prepared to demonstrate the presence of supplied products, cabling and installation methods. The Contractor shall be prepared to demonstrate the operation of all systems (and each requested component thereof) and shall be prepared to make electronic, physical or software related adjustments to the system or any of its components to the satisfaction of the Designer.

I. Corrective actions may not be undertaken by the Contractor during Acceptance Testing that in any way impedes Acceptance Testing progress or negatively alters the day's schedule.

J. Acceptance Testing shall not pass if any of the following conditions are true.
1. Inspections do not substantially match the Pre-Acceptance Submittal.
2. Inspections do not match the criterion of these specifications.
3. The Contractor's workmanship does not appear to be of professional quality.
4. The Contractor has failed to follow established installation requirements.
5. As-built drawings have not been presented to the Designer prior to the commencement of Acceptance Testing.
6. As-built drawings are found to be incomplete or inaccurate.
7. More than one cable is found to be missing a required label.
8. More then one cable is found to be inaccurately recorded on the as-built drawings.
9. Installed equipment does not match the equipment specified and/or previously authorized for use by the Designer.

10. More then one unit of equipment, cable, connector, circuit, etc… fails to pass a test performed on it.
11. There are substantive workmanship issues judged by the Designer to be negative and are of material importance to the long-term usability, safety, professional appearance, or service and maintainability of the Contractor's work.
12. There is any material deviation from the intent of these specifications.

K. Contractor is entitled to no more then (2) acceptance testing visits per system. One primary visit and one follow-up (secondary) visit. The Contractor is responsible for reimbursement of Designer fees associated with each additional visit that is the result of the Contractor's failure to be complete; the Contractor's failure to comply with the requirements of the contract documents; or the Contractor's failure to be fully prepared for acceptance testing at the date and time scheduled. The cost for subsequent acceptance testing visits shall be $1500 per person, per day, plus travel and other expenses.
1. An Acceptance Testing report (i.e. punch list) will be supplied by the Designer following each official Acceptance Testing visit enumerating issues found during the visit.

L. Should the Designer conclude that the Contractor has inaccurately represented the level of completion, the Designer reserves the right to abort the balance of the days' scheduled acceptance testing and the Contractor shall be docked one acceptance testing visit for each system not evaluated.

3.4 TRAINING

A. Training shall be supplied for each section of this Division and for each unique system provided.

B. The Owner shall have the right to use total allocated training for a period of (365) calendar days following final completion of onsite work, solely at its discretion.

C. Training shall be supplied as expressly identified within individual sections. Where training requirements are not otherwise expressly identified, the Contractor shall supply a minimum of (2) hours per unique system, per section. The Contractor shall presume that at least (2) discrete trips to the project site shall be required per unique system to conduct training.

D. Training dates and times shall be coordinated with the Owner's designated training representative(s).

E. Training shall cover the following:
1. Normal system use and operation
2. Procedures and schedules involved in troubleshooting and performing routine preventative maintenance.
3. Other facets as identified in individual sections

F. Agenda and relevant training handouts shall be prepared and distributed to attendees at each training session.

G. A sign-in sheet shall be created and used for each training session. The sheet shall:
1. The section and system(s) being trained upon.
2. The date and starting time of the session.
3. The signatures of all attendees.
4. The ending time of the session, along with a separate owner signature certifying the ending time.
5. Have attached to it a copy of the training outline/agenda.

H. Recording of Sessions
1. When a related section requires recording of supplied training sessions they shall be recorded.
2. Recordings shall be supplied on DVD video format media playable in standard consumer grade reproduction appliance. Recordings do not need to be professionally edited but shall feature intelligible audio and a clear image of the subject trainer and any supplemental visual content material to the training.

3. Recordings shall be turned over and signed for by an Owner's training representative at the end of each session. A copy of a signed delivery receipt shall be included as part of the Contractor record documentation.
4. Contractor shall require each attendee to sign-in at the start of each training session. The sign-in form shall summarize the training conducted, specification section and system being trained on, as well as the starting time and duration of training. Following training, a representative of the Owner shall sign the form, acknowledging the same. Contractor shall retain the original copy of these forms and turn over a photo copy of the form to the Owner's representative as evidence of training. Training conducted without this official record of training shall not be considered as part of the Contractor's training obligation.

I. In order for all training sessions to count towards the Contractor's training obligation, each of the following shall be met.
1. Training occurs after Training Submittal review.
2. Training session outlines/agenda are distributed at each session.
3. Quality Assurance requirements for trainer have been met.
4. Training occurs after the system / section is fully complete and working (usually following final Acceptance Testing). Training in advance of this requires Designer approval.
5. Contractor fully complies with sign-in sheet requirements for every session.
6. Contractor maintains a master training log.

END OF SECTION 27 00 01

SECTION 27 05 02

BASIC MATERIALS AND METHODS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. All work performed shall be performed in accordance with all Codes applicable at the project site. The authority having jurisdiction shall have the final say as to whether code compliance has been achieved.

B. Wherever the contractor believes, or the authority having jurisdiction advises, that work required by these contract documents is in conflict with applicable codes, the Contractor shall immediately advise and seek the direction of the Designer.

1.2 TOOLS

A. Tools shall be used only for the purpose for which they are designed.

B. Specialty tools shall be used for assembly, installation, termination, and removal of products as recommended by the product manufacturer.

C. The designer reserves the right to require removal and replacement of any product installed using incorrect tools.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate installation of pathways before installation of pathways, including when pathways installation is not work of This Contractor.

B. Review pre-existing pathways prior to installation of work and report to the Designer any discrepancies between specified pre-existing pathway conditions and actual existing pathway conditions.

C. Coordinate with all other Contractors and the Owner, as applicable and necessary to ensure clean, professional looking and operating systems.

D. Participate in coordination efforts through the preparation of shop drawings and details prior to fabrication or installation of any products. Coordinate actual clearance requirements of installed products.

E. Begin coordinate immediately upon award of contract. Coordinate work with all other trades and adjust equipment locations accordingly. Refer to coordination drawings prepared by other trades; generate and supply the same for use by other trades.

F. It is generally intended that all apparatus be located symmetrical with architectural elements and shall be installed at the heights and locations shown on the drawings. If a device height or location is in question it shall be the responsibility of the Contractor to immediately seek clarification of the Designer.

G. The Contractor shall fully inform himself regarding all peculiarities and limitations of space available for installation of all work and materials furnished and installed under the contract. He shall exercise due and particular caution to determine that all parts of his work are made quickly and easily accessible. Although the locations of equipment and conduit may be shown on the drawings in certain positions, the architectural details and conditions existing at the job site shall guide the Contractor, coordinating his work with that of others. Provide all necessary offsets to provide a neat workmanlike arrangement.

H. Plans are generally diagrammatic and indicate the design intent, required sizes, points of termination and, in some cases, suggested routes of raceways, etc. However, it is not intended that plan drawings indicate fully coordinated routing and placement, all necessary offsets, etc…

I. Contractor shall refer to all drawings, including enlarged plans, elevations, sections, and details for additional information that may include dimensions and greater resolution and notes that serve to refine the intent and further assist and guide the Contractor.

J. The Contractor shall work in harmony with all other contractors and subcontractors performing work at the project site, so as not to cause any delays in pouring concrete, building masonry walls, etc. This Contractor shall consult ALL project drawings, including those predominately used by other trades before installing his work so as to ensure that his work will not interfere with or be adversely affected by work of other trades. This Contractor shall take all necessary steps to ensure a coordinated installation of his work.

K. This Contractor shall attend all regularly scheduled project meetings as well as any special meetings called to coordinate and/or resolve special issues that arise during the course of the project.

L. Conflicts in equipment and materials shall be corrected prior to installation. Should there be a conflict with drawings of other trades, this Contractor shall work with the trades to correct the conflict while coordinating the project (prior to installation). If the conflict cannot be resolved, refer the matter to the owner's representative for a final decision as to method or material. This Contractor shall refer to drawings of all other trades for details, dimensions and locations of other work and route their work so as not to conflict with any other branch. Any work installed or equipment placed in position by this Contractor creating a conflict shall be readjusted to the satisfaction of the owner's representative at the expense of this Contractor.

3.2 INSTALLATION

A. General
1. Work installed in finished areas shall be concealed. Work installed in unfinished areas may be exposed at the discretion of the Owner's representative and approved in writing.
2. Sequence, coordinate, and integrate installations of communications materials and equipment with the work of other trades for efficient flow of the Work.
3. Install systems, materials, and equipment to conform with reviewed submittal data, including coordination drawings, to greatest extent possible.
4. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and architectural/structural components.
5. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.
6. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
7. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
8. Verify all dimensions by field measurements. Take measurements and be responsible for exact size and locations of all openings required for the installation of work. Figured

dimensions are reasonably accurate and should govern in setting out work. Where detailed method of installation is not indicated or where variations exist between described work and approved practice, direction of the owner's representative on job shall be followed.

9. The symbols used to indicate the purpose of various outlets is identified in the
10. Legend.
11. The conductors terminating at each wired outlet shall be left not less than 8" long at their outlet fittings to facilitate installment and servicing of devices.
12. If during construction it becomes apparent that certain minor changes in layout will affect a neater job or better arrangement, such alterations shall be made as part of the contract. Designer's review shall be obtained before making such changes.
13. Workmanship throughout shall conform to the standards of best practice. Marks, dents or finish scratches will not be permitted on any exposed materials, fixtures or fittings. Inside of panels and equipment boxes shall be left clean.
14. All termination types shall correctly match cable and device termination point.
15. As an illustration if “spade lug” type of termination is appropriate then the spade lug cable entry size should match the cable used. The spade lug shall also have the correct stud size to match the terminal to which it will be connected. Terminations shall be completed with tools designed and sized for the specific application and connector.
16. Use caution not to exceed the manufacture allowed bending radius for cables and not to compromise the integrity of the cables during installation by pulling cable management devices too tightly, damaging cables, etc. Raceway/Cabling bending radii shall be minimum as directed by cable manufacturer. Use pulling compound or lubricant, where necessary, but ensure that the type of compound is compatible with and will not deteriorate the conductor or cable insulation.
17. Neatly dress all cable work and provide vertical and horizontal cable management (or other approved method) for properly dressing all work at racks, control panels, backboards etc. See detail(s) and other drawings for additional information.
18. Low-voltage cables shall be kept as far from electrical cables and equipment as possible. Avoid running low-voltage cables parallel to medium and high- voltage cables. When parallel runs cannot be avoided, keep low-voltage cables at least 24 inches away and cross cables at 90 degrees to minimize the risk of interference.
19. Avoid running low-voltage cables any closer than 24 inches to any ballast type lighting fixture or other high RF energy producing device.
20. All cables shall be supported/anchored at maximum 4 foot intervals and within
21. 12" of box or outlet. All cables shall be neatly bundled and secured to discrete cable supports at four-foot intervals.
22. Furnish color-coded cable jackets to identify runs of different systems.
23. Neatly route cables parallel and perpendicular to building architectural lines.
24. Neatly comb out multiple cable bundled runs to remove tangling and crossing of cables within the bundles.
25. All cable assemblies, etc. shall be run as straight as possible and symmetrical (perpendicular to or parallel with) with architectural items and in a consistent elevation. Work installed diagonal to building members shall not be permitted.

B. Cable Separation

1. Cables for each system shall be installed separately and isolated from cables from other systems.
2. Cables carrying signals of different types and different nominal operating levels shall be kept separated to reduce the risk of undesirable interference and cross- talk between cables.
   a. As a general rule, for each 25dBV difference in nominal operating level between cables, Contractor shall provide at least 6 inches of separation. Example 1: cables with a 75dBV level difference between them shall be separated by 18 inches or greater. Example 2: Cables with a 13dBV difference between them shall be separated by 3 inches or greater.
   b. Contractor shall provide additional separation to prevent and to remedy any crosstalk that adversely affects the performance and usability of the system, or that exceeds specific crosstalk performance guidelines defined elsewhere in these specifications.
3. In common areas where cables from multiple systems are run in general proximity to one another, cables from each system shall be labeled to identify the system the cables serve.

C. Cable Splices

1. Splices shall not be permitted in any cable except where expressly specified and/or approved by the Designer.
2. In cases where splices are specified and/or otherwise approved, splices shall be made within UL listed junction or device boxes. Open air connections shall not be permitted.

D. Cable Terminations
1. Where field installed cables connect to manufactured products via pig-tails or connectorized cable assemblies, all terminations shall be made within the product enclosure or within a UL approved junction or device box. Open air connections shall not be permitted. Exposed and open air spices are not acceptable.

E. Strain Relief Permanently installed cables shall be properly secured with an approved device. Strain relief shall be applied typically within 6-inches from the point of entry into a product enclosure, junction box, pull box, or device box. When properly applied the strain relief device shall not damage the cable being secured and shall not permit movement of the cable in any way that may adversely affect the long term integrity of nearby connections.

F. Identification
1. General
   a. All identification shall be in English except where otherwise noted.
   b. Where identification is applied to surfaces that require a finish, install identification after the surface finish is applied.
   c. Labeling products, color, sizes, nomenclature and the installed location of the identification product are all subject to the Designer's review and approval.
2. Cables
   a. Every installed cable shall be uniquely labeled at each end of the cable.
   b. Cables shall be labeled using permanent self-laminating type labels containing computer generated permanent type-written text.
   c. Nomenclature shall be bold-type and clearly readable by a person with average sight, and typical lighting conditions within the area of installation.
   d. Labels shall be applied approximately 6 cable-inches from the point of termination.
   e. Cables installed and intended for future use shall be clearly identified as such and the label shall clearly indicate the location of the opposite end of the cable.
   f. Every cable installed shall be recorded in the project record documents.
3. Boxes
   a. Junction boxes and pull boxes shall be labeled on their interior and on their exterior covers with the identity of the system(s) the box serves along with the function of the box. Interior markings shall be made using permanent marker. Permanent marker may also be used on the cover of boxes installed in concealed areas (above accessible ceilings for example). Exposed boxes shall be labeled with engraved plastic cables. Labels shall closely match the color of the box.
   b. Device boxes, when first installed, shall be identified on their interior with a permanent marker to identify the system(s) the box servers and to identify the device the box will contain.
4. Equipment Racks, Cabinets, Enclosures
   a. Engraved plastic labels shall be generated and applied to all equipment racks, cabinets, equipment enclosures, etc…
   b. The nomenclature, color, size, installed location, and type of all labels are subject to the Designer's review and approval.
5. System Equipment
   a. Each piece of active and passive system equipment shall be uniquely identified using labels and nomenclature acceptable to the Designer.
   b. Front panel controls of equipment shall be labeled with nomenclature meaningful to the end user based on the intended use of the equipment in the system. Examples include, but are not limited to:
      1) Label router/matrix control panels with system specific input/output names.
      2) Label patch panels with meaningful input/output destination names
      3) Label mixer input and output controls to identify the signal source and destination.
   c. Professionally prepared, installed and readily visible "cheat sheets" may be acceptable under select circumstances with the approval of the designer.

d. The nomenclature, color, size, installed location, and type of all labels are subject to the Designer's review and approval.

G. Medium and High Voltage Cabling (> 71 Volts)
1. Cabling that will carry voltages higher then 71 Volts AC or DC shall be installed and terminated only by persons licensed to perform such work within the area of jurisdiction.

H. Plates and Panels
1. Device plates/panels shall be installed flush against the surface over which the plate/panel is mounted (e.g. there shall be no visible gap between the backside of a plate/panel and the wall, ceiling or floor; there shall be no visible gap between the backside of plate/panel and a surface mount box to which the plate/panel mounts). Advanced craftsmanship and construction techniques shall be employed where necessary to achieve this.
a. The same shall apply to other wall and ceiling mounted products.
2. Cover plates shall match finish and color of other wiring devices in this project. Refer to Section 26 27 26 "Wiring Devices" for requirements.

I. Device Boxes, Pull-Boxes, Junction Boxes
1. Boxes installed in walls and ceilings shall be installed so that the box does not stand proud (protrude out beyond) of the finished surface. Boxes shall be installed such that when the mounted devices and cover plates are installed that the backside of the cover plate rests flush with the finished surface of the wall or ceiling. Advanced craftsmanship and construction techniques shall be employed where necessary to achieve this.

3.3 GROUNDING

A. All equipment shall be properly grounded for safety and to ensure satisfactory performance of systems and equipment.

3.4 CUTTING, PATCHING AND SEALING

A. General
1. The Contractor shall perform all cutting as required for the admission of work.
2. Unless directed otherwise in field, provide all related patching and painting tomatch surrounding methods, materials and colors. Any damage done by this Contractor to the building during the progress of this Contractor's work shall be made good at this Contractor's expense. Perform cutting, fitting, and patching and materials as required to:
a. Uncover Work to provide for installation of ill-timed Work.
b. Remove and replace defective Work.
c. Remove and replace Work not conforming to requirements of these
d. Contract Documents.
e. Remove samples of installed Work as specified for testing.
f. Install equipment and materials in existing structures.
3. Upon written instructions from the owner's representative, uncover and restore work to provide for observation of concealed work by owner's representative or by inspection authority having jurisdiction.
4. During cutting and patching operations, protect adjacent installations (structure, finishes, furnishings, etc.). Where applicable, provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to system components and components of other trades.
5. Patch surfaces and building components using new materials matching existing materials and using experienced Installers. Refer to Division 1 for definition of experienced "Installer" or determine qualifications as directed in field by owner's representative.
6. Patching through fire rated walls and enclosures shall not diminish the rating of that wall or enclosure. All materials used for patching shall be installed to meet or exceed the smoke and fire rating of the respective surface being patched.
7. Neatly cut and drill all openings in walls and floors required for the installation.

8. Secure approval of Owner's Representative before cutting and drilling in existing facilities. Neatly patch all openings cut.
9. Cutting and patching shall be held to a minimum by arranging with other
10. Contractors for all sleeves and openings before construction is started.
11. Provide factory-assembled watertight wall and floor seals, of types and sizes required; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
12. Pipe sleeves shall be fabricated from Schedule 40 rigid, heavy wall, full weight galvanized steel pipe; remove burrs. Use sleeves which are two standard sizes larger than conduit passing through respective sleeve.
13. Provide sleeve seals for piping which penetrates foundation walls below grade, exterior walls or roofs, caulk between sleeve and pipe with non-toxic, UL- classified caulking material to ensure watertight seal. Elsewhere modular provide mechanical type seals, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
14. Install standard Schedule 40 black steel pipe sleeves two sizes larger than pipes passing through floors, bearing walls, fire walls and masonry construction. Sleeves through walls shall be cut flush with both faces. Sleeves through floor shall extend one inch above floor top elevation. Pipes penetrating roof shall use a pipe curb assembly equal to Pate Co. Furnish and set all forms required in masonry walls or foundation to accommodate pipes.

B. Grout
1. Provide non-shrink, nonmetallic grout, pre-mixed, factory-packaged, non- staining, non-corrosive, and non-gaseous grout, recommended for interior and exterior applications.

C. General Joint Sealer Application
1. Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
2. Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.
3. Clean all affected surfaces, joints, etc. immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
4. Apply sealant primer to substrates as recommended by manufacturer. Protect adjacent areas from spillage and migration of sealant, using masking tape. Remove tape immediately after tooling without disturbing seal.
5. Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
6. Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
7. Colors for exposed seals shall be as selected by the Owner's representative from manufacturer's standard colors.

3.5 FIRESTOPPING

A. Cables and penetrations through building walls, floor and ceilings shall be fire-stopped in accordance with Code, these specifications and related drawings.

END OF SECTION 27 05 02

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide the labor, tools, equipment, and materials necessary to furnish and install telecommunications grounding system in accordance with the plans and as specified herein. Provide all accessories as necessary for a complete system.

B. Provide communications system-grounding conductor at point of service entrance and connect to Telecommunications Main Grounding Busbar (TMGB). Bond together the communications system grounding.

C. This section includes the following:
1. Telecommunications Main Grounding Busbar (TMGB)
2. Telecommunications Grounding Busbar (TGB)
3. Telecommunications Bonding Backbone (TBB)
4. Telecommunications Bonding Conductor (TBC)

1.2 SUBMITTALS

A. Product data for TMBG, TGB, and TBB.

B. Ground resistance testing results certified by the testing organization.

C. Schematic diagram of the telecommunications grounding system.

1.3 QUALITY ASSURANCE

A. All equipment shall be UL listed and labeled for their intended usage.

B. All equipment shall comply with the latest National Electric Code.

C. All equipment shall comply with the latest TIA/EIA-607, and BICSI standards.

PART 2 - PRODUCTS

2.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

A. Provide Telecommunications Main Grounding Busbar (TMGB) in MDF Room.

B. The TMGB shall have minimum dimensions of ¼-inch thick x 4-inch wide and 12-inch in length. The length may need to be adjusted longer to meet the application requirements with consideration of future growth. The busbar shall be UL Listed as grounding and bonding equipment.

C. The TMGB shall be a predrilled solid copper busbar provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607-A and shall accept 15 two-hole grounding lugs with 5/8" hole centers and 3 two-hole lugs with 1" hole centers. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4" standoff from the wall.

2.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

A. Provide Telecommunications Grounding Busbar (TGB) at IDF and all Communications Equipment Racks.

B. The TGB shall have minimum dimensions of ¼-inch thick x 2-inch wide and 10-inch in length with 7 attachment points (one row). The length may need to be adjusted longer to meet the application requirements with consideration of future growth. The busbar shall be UL Listed as grounding and bonding equipment.

C. The TGB shall be a predrilled copper busbar provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607-A and shall accept 4 two-hole grounding lugs with 5/8" hole centers and 3 two-hole lugs with 1" hole centers. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4" standoff from the wall.

2.3 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

A. Provide Telecommunications Bonding Backbone (TBB) between all TGBs and the TMGB.

B. All TBB Connections to be made with double-bolted, Compression style, Grounding Lugs.

C. The TBB shall be a minimum of #1/0 AWG insulated copper bonding conductor.

2.4 TELECOMMUNICATIONS BONDING CONDUCTOR (TBC)

A. Provide conductors used to bond components to the TMGB and the TGBs as follows:

1. Avoid unnecessary connections or splices in TBCs. When necessary, use an approved connection and position it in an accessible location.
2. Typical connections are made by using: bolts or crimps (connectors, clamps, or lugs). Where possible, use irreversible compression-type connections and two-hole lugs. Always use listed hardware that has been laboratory tested.

PART 3 - EXECUTION

3.1 INSTALLATION

A. As a minimum, Bond TMGB to following:

1. Building Steel (minimum #1/0 AWG insulated copper bonding conductor). Attach Bonding Conductors to Building Steel using listed exothermic welding process.
2. Main Electrical Service Ground (minimum #1/0 AWG insulated copper bonding conductor).
3. Local Service Panel Ground.
4. Telecommunications Bonding Backbone (TBB) that connects TMGB to other TGBs (minimum #1/0 AWG insulated copper bonding conductor).
5. Associated Telecommunications Cable Tray(s).
6. Telecommunications Conduit(s) Entering TR.

B. As a minimum, Bond TGB to following:

1. Building Steel (minimum #1/0 AWG insulated copper bonding conductor). Attach Bonding Conductors to Building Steel using listed exothermic welding process.
2. Local Service Panel Ground.
3. Telecommunications Bonding Backbone (TBB) that connects TGB to other TGBs and TMGB (minimum #1/0 AWG insulated copper bonding conductor).
4. Associated Telecommunications Cable Tray(s).
5. Telecommunications Conduit(s) Entering TR (continuous minimum #6 AWG bare copper bonding conductor connecting all cable tray sections).

C. As a minimum, the Technology Contractor shall bond the following devices to the associated TMGB and TGBs using a minimum #6 AWG insulated copper bonding conductor using 2-hole compression style lugs:
1. Equipment Racks and Cabinets
2. Cable Ladder and Tray
3. Surge Protectors
4. Telecommunications Devices
5. Coupled Bonding Conductors (CBCs)
6. Backbone Cable Shields
7. Telecommunication and Fiber Cable Shields

D. General:
1. Route ground conductors to provide the shortest, most direct path from point to point. Telecommunications ground must be bonded to the lightning protection system ground.
2. Bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place bonding conductors in ferrous metallic conduit that exceeds 3 feet in length, the conductors shall be bonded to each end of the conduit with a conductor sized as a #6 AWG, minimum (this makes the conduit a parallel path with the cable).
3. A continuous ground path shall be provided in all telecommunications raceways. Grounded cable trays shall be considered continuous ground path.
4. At each Telecommunication Room (TR) all equipment and raceways shall be bonded to the TGB.
5. Any grounding or bonding conductor that is run through a metallic conduit shall be bonded to the conduit.
6. Provide dedicated Telecommunications Bonding Backbone (TBB) to interconnect the TRs and related equipment.

E. Telecommunications Entrance Facility (TEF) Telecommunications Main Grounding Busbar (TMGB):
1. The Telecommunications Main Grounding Busbar (TMGB) serves as the dedicated extension of the building grounding electrode system for the telecommunications infrastructure. The TMGB also serves as the central attachment point for telecommunications bonding backbones (TBB) and equipment, and is located such that it is accessible to telecommunications personnel.
2. The TEF is the desirable location for the TMGB. This TMGB may serve as the TGB for collocated equipment in the TEF. The TMGB shall be bonded to electrical service equipment ground. This bond at the TMGB shall use a double bolted, compression style grounding lug. The bond at the electrical service equipment ground shall use an exothermically welded connection.
3. Where an electrical panelboard is located in the same room or space as the TMGB, the ground or enclosure of that electrical panelboard shall be bonded to the TMGB. Locate the TMGB as close to the electrical panelboard as practical to maintain clearances required by applicable electrical codes.
4. Locate the TMGB near the TBB cabling and associated terminations. The connections of the bonding conductors for telecommunications, and the TBBs to the TMGB shall utilize listed two-hole compression lugs.
5. Telecommunications primary protector grounding conductor shall be bonded to the TMGB. A minimum of 1 foot separation shall be maintained between this insulated conductor and any DC power cables, switchboard cables, or high frequency cables, even when placed in metal raceway.
6. All metallic raceways for telecommunications cabling located within Equipment Room (ER) shall be bonded to the TMGB. However, for metallic raceways containing grounding conductors where the raceway is bonded to the ground conductor, no additional bonding to the TMGB is required.

7. In buildings where the backbone telecommunications cabling incorporates a shield or metallic member, this shield or metallic member shall be bonded to the TMGB where the cables are terminated or where pairs are broken out.
8. In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the mdf; each TMGB shall be bonded to the vertical steel metal frame.

F. Telecommunications Room (TR) Telecommunications Grounding Busbar (TGB):
1. The TGB is the grounding connection point for telecommunications systems and equipment in the location served by that TR or ER. Each TR and ER shall contain a TGB. Multiple TGBs may be installed within the same TR or ER to aid in minimizing bonding conductor lengths and terminating space. In all cases, multiple TGBs within the same ER shall be bonded together with a conductor the same size as the TBB.
2. The TGB shall be located near the TBB cabling and associated terminations.
3. The bonding conductor between a TBB and TGB shall be continuous and routed in the shortest possible straight-line path. The bonding conductor shall be the same size as the TBB.
4. All metallic raceways for telecommunications cabling located within TR shall be bonded to the TGB. However, for metallic raceways containing grounding conductors where the raceway is bonded to the ground conductor, no additional bonding to the TGB is required.
5. In buildings where the backbone telecommunications cabling incorporates a shield or metallic member, this shield or metallic member shall be bonded to the TGB where the cables are terminated or where pairs are broken out.
6. In a metal frame (structural steel) building, where the steel framework is readily accessible, each TGB shall be bonded to the vertical steel metal frame. When practicable because of shorter distances and other considerations, and where horizontal steel members are permanently electrically bonded to vertical column members, TGBs may be bonded to these horizontal members in lieu of the vertical column members.

G. Telecommunications Bonding Backbone (TBB):
1. A TBB is a conductor that interconnects all TGBs with the TMGB. A TBB's basic function is to reduce or equalize potential differences between telecommunications systems bonded to it. A TBB is not intended to serve as the only conductor providing a ground fault current return path.
2. A TBB shall be designed with consideration given to the type of building construction, the telecommunications requirements, and the configuration of the telecommunications pathways and spaces. Specifically, the design of a TBB shall:
   a. Be consistent with the design of the telecommunications backbone cabling system.
   b. Address routing to minimize the lengths of the TBB.
3. All TBB Connections to be made with double-bolted, Compression style, Grounding Lugs.
4. TBB conductors shall be installed without splices. Where splices are required, they shall be kept to the minimum quantity necessary, shall be accessible and located in telecommunications spaces. Joined segments of a TBB shall be connected using irreversible compression-type connectors or exothermic welding. All joints shall be adequately supported and protected from damage.

H. Telecommunications Bonding Conductors (TBC):

1. Bonding conductor sizing. The following applies to the Telecommunications Bonding Conductor (TBC):
   a. Bonding Conductor Length (ft) / Bonding Conductor Size (AWG)
      1) <13 / #6
      2) 14-20 / #4
      3) 21-26 / #3
      4) 27-33 / #2
      5) 34-41 / #1
      6) 42-52 / #1/0
      7) 53-66 / #2/0
      8) >66 / #3/0

3.2 FIELD QUALITY CONTROL

A. Testing Telecommunications Grounding and Bonding Infrastructure:

1. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Measure ground resistance from longest grounding path to TMGB or TGB in TR or ER. Resistance shall not exceed 0.1 ohms

END OF SECTION 26 05 26

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SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Complete and working pathway systems for communications and related system cabling, including pathways designated as spare(s) and/or reserved for future use
   2. Section includes but is not necessarily limited to:
      a. Conduit, fittings and supports
      b. Surface raceway, fittings and supports
      c. Discrete cable supports, fittings and supports
      d. Cable tray, fittings and supports
      e. Wall, floor, ceiling and roof penetrations
      f. Miscellaneous pathway accessories

1.2 DEFINITIONS

A. Primary Pathways – Those pathways typically located in corridors, dedicated vertical cable chases and used to enclose and/or support large quantities of compatible signal cables from one or more systems to the general area where system devices are located. Cables carried by a primary pathway transfer to secondary pathways.

B. Secondary Pathways - Those pathways typically extending from a primary pathway to the space near the system device to be served. A secondary pathway typically accommodates 16 or less cables of compatible signals, from a single system.

1.3 SYSTEM DESCRIPTION

A. General
   1. The pathway systems for communication shall consist of all products necessary to support, protect, enclose, manage and secure cables used for communications and related systems. The pathway system for each system may vary based up the requirements of these specifications and information on the drawings.
   2. The total pathway system shall include code-compliant penetrations through walls, floors, ceilings, roofs, etc… as necessary for the routing of cables between their intended starting and ending points.

B. Pathway System(s) for Telecommunications (Voice/Data/Network) Cabling
   1. The pathway system for the Telecommunications cabling system shall be a hybrid pathway system consisting of a mixture of cable tray, conduit, discrete cable supports, conduit sleeves, and device boxes, pull boxes and junction boxes.
   2. The pathway system shall be assembled from UL listed components.
   3. The pathway system shall be NFPA 70 and the “National Electrical Code”
   4. compliant.
   5. The pathway system shall be built so that no pathway segment shall exceed a
   6. 40% cable fill. Larger pathway segments (conduits, cable tray, discrete cable supports etc…) shall be provided where indicated on the drawings.
   7. The pathway system shall include all products necessary to render the system usable for its intended purpose

8. The minimum conduit size permissible for use in this system shall be 1".

C. Pathway System(s) for other Communications Systems
   1. General
      a. Unless otherwise noted on the drawings, the pathway system for each of the following systems shall be a hybrid pathway system consisting of a mixture of cable tray, conduit, discrete cable supports, conduit sleeves, and device boxes, pull boxes and junction boxes.
      b. The pathway system shall be assembled from UL listed components.
      c. Conduit sizes used for the system shall support a cable fill percentage not exceeding 40%. Larger pathway segments (conduits, cable tray, discrete cable supports etc…) shall be provided where indicated on the drawings.
      d. Each system shall include all products necessary to render the system usable for its intended purpose
   2. Building Intercommunication Systems
      a. Minimum conduit size for this system is 3/4".
   3. Paging Systems
      a. Minimum conduit size for this system shall be 3/4".
   4. Audio/Visual Systems
      a. Minimum conduit size is 3/4".
   5. Sound Reinforcement Systems
      a. Minimum conduit size is 3/4".
   6. Pathways for other work of Division 27
      a. Minimum conduit size is 3/4".

1.4 SUBMITTALS

A. Product Data
   1. Surface Raceway
   2. Cable Tray
   3. Floor Boxes
   4. Device Boxes
   5. Box Eliminators
   6. Cable Spillways
   7. Discrete Cable Supports

B. Shop Drawings
   1. Floor plans depicting the intended location of the following:
      a. Primary pathways
      b. Secondary pathways
      c. Planned penetrations through ceilings, floors, walls and the roof.
   2. Riser diagrams of each closed conduit systems used by communication systems.

C. Closeout Submittals
   1. Floor plans depicting the as-installed location of the following:
      a. Primary pathways
      b. Secondary cabling pathways
      c. Locations of all penetrations and conduit sleeves
      d. Fire-rated penetration locations, along with rating value.
   2. Penetration Certification Documentation
      a. Certification paperwork for all penetrations through fire-rated building surfaces and cavities.

1.5 QUALITY ASSURANCE

A. All products shall be UL–type listed for the location and application in which it is used.
   1. All onsite personnel shall be manufacturer trained on the anchoring system being utilized.

2. Building penetrations shall be performed by person(s) properly trained on the installation of specific rated assembly being installed.
3. Installation material and practices shall fully comply with NFPA 70, "National Electrical Code" and ANSI/TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Conduit
1. Rigid steel conduit:
   a. Threaded rigid steel conduit shall be manufactured from mild steel, zinc galvanized both inside and outside including threads. It shall be constructed in accordance with ANSI C80.1, Federal Specification WW- C-581;
2. Intermediate metallic conduit:
   a. Threaded intermediate metallic conduit shall be manufactured from mild steel, zinc galvanized both inside and outside including threads. It shall be constructed in accordance with ANSI C80.6, Federal Specification WW- C-581;
3. Electric metallic tubing:
   a. Electric metallic tubing shall be manufactured from mild steel, zinc galvanized both inside and outside. It shall be constructed in accordance with ANSI C80.2, Federal Specification WW-C-563;
4. Flexible metallic conduit:
   a. Flexible metallic conduit with neoprene jacket shall be spirally wound steel, strip zinc galvanized both inside and outside, integral ground conductor.
5. Non-metallic raceways
   a. Polyvinylchloride (PVC):
      1) PVC conduit shall be virgin C300 type, Schedule 40 or 80 (90□ C).
      2) Constructed in accordance with NEMA TC2 and Federal Specifications W-C-1094A.

B. Discrete Cable Supports (J-Hooks)
1. General
   a. Discrete cable supports with round surfaces (i.e. bridal rings) are not acceptable for use.
2. Primary Pathways
   a. J-Hook style support.
   b. Plenum rated construction.
   c. Steel construction, galvanized finish
   d. Complies with UL, cUL, NEC, and ANSI/TIA/EIA requirements for structured cabling systems.
   e. Basis of Design:
      1) 50 UTP Category 6 cable capacity: Erico CABLECAT32xx
      2) 185 UTP Category 6 cable capacity: Erico CABLECAT34xx
   f. Additional approved manufacturers: B-Line, Panduit
   g. See manufacturer's installation guidelines for additional quantity and sizing guidelines.
3. Secondary pathways
   a. Plenum rated.
   b. J-hooks style support
   c. Steel construction, galvanized finish
   d. Complies with UL, cUL, NEC, and ANSI/TIA/EIA requirements for structured cabling systems.
   e. Basis of Design:
      1) 10 UTP Category 6 cable capacity: Erico CABLECAT12xx
      2) 32 UTP Category 6 cable capacity: Erico CABLECAT21xx
   f. Additional approved manufacturer(s): B-Line, Panduit
   g. See manufacturer's installation guidelines for additional quantity and sizing guidelines.

2.2 FITTINGS

A. Rigid steel or intermediate metallic conduit:
   1. Fittings shall be threaded zinc galvanized steel.
   2. At least one bushing shall be grounding type
      a. Equipped with a ground lug
      b. Provide on each conduit or sleeve where surface extends below ceiling line.

B. Electric metallic tubing:
   1. Fittings shall be compression type.
   2. At least one bushing shall be grounding type
      a. Equipped with a ground lug
      b. Provide on each conduit or sleeve where surface extends below ceiling line.

C. Flexible metallic conduit:
   1. Fittings shall be suitable for the specific application.
   2. Use oil-tight fittings with neoprene jacketed flexible metallic conduit.

D. Non-metallic conduit:
   1. Fittings shall be of the same type and manufacturer as the raceway, connected in accordance with manufacturer's written instructions.

E. Expansion:
   1. Expansion fittings shall be of a type suitable for the particular condition and shall be complete with bonding jumper.

2.3 BOXES

A. Wall/Ceiling Outlet Style Device Boxes
   1. General:
      a. Stamped steel, code gauge, galvanized, minimum 2 ½ inches deep. Provide deeper boxes where indicated on the drawings.
      b. Corrosion protection suitable for the atmosphere in which they are installed.
      c. Non-gangable sheet-steel box construction
      d. Conduit knockouts of the size and quantity and box locations required.
      e. Threaded device mounting screw holes.
      f. Rated for installation in the space where the box will be installed
   2. Boxes Used in Masonry or Tile Walls
      a. Galvanized steel construction
      b. "Masonry" style box construction
      c. Available in standard gang sizes from 1 to 6
      d. Various depth sizes available from 2.5 to 3.5 inches
      e. Conduit knockouts to suit the application
   3. Boxes used in Gypsum Board Walls
      a. Galvanized steel construction
      b. "Masonry" style box construction
      c. Available in standard gang sizes from 1 to 6
      d. Various depth sizes available from 2.5 to 3.5 inches
      e. Conduit knockouts to suit the application
   4. Approved Manufacturers: Adalet, Appleton Electric, Bell Electric, Bowers, Eagle Electric, Mfg Co., Inc., Midland-Ross Corp., OZ/Gedney., Pass and Seymour, Inc., RACO, Hubbel, Thomas & Betts Co., Thepitt.

B. Exterior Surface Mount Outlet Style Boxes
   1. Hinged cover, sized to accommodate the devices being mounted to the box.
   2. Cast Aluminum construction
   3. Available in standard gang sizes from 1 to 3
   4. Threaded conduit hubs

5. Approved Manufacturers: Adalet, Appleton Electric, Bell Electric, Bowers, Eagle Electric, Mfg Co., Inc., Midland-Ross Corp., OZ/Gedney., Pass and Seymour, Inc., RACO, Hubbel, Thomas & Betts Co., Thepitt.

C. Surface Raceway Device Boxes
1. Designed to work with the surface raceway system to which they attach
2. Factory finished to matching the associated raceway.
3. Available in standard gang sizes of 1 to 3 gangs.
4. Sized to suit the devices they are intended to accommodate.
5. Available in a variety of box depths, including custom manufactured box depths up to 3-1/2 inches.

D. Junction and Pull boxes:
1. Conduit System Junction and Pull Boxes
   a. Screw cover type enclosure, except where otherwise noted.
   b. Screw covers installed in unfinished spaces, above ceilings, in utility rooms shall be provided with covers of the same finish and material construction as the box itself.
   c. Boxes installed flush in wall shall be provided with oversize cover plates painted to match the surrounding building surface.
   d. Boxes shall be NEMA rated for the atmospheric condition in which the box is installed.
   e. Boxes in exterior or moist locations shall meet NEMA 3R (at minimum)
2. Surface Raceway Junction and Pull Boxes
   a. As manufactured by the surface raceway manufacture and designed to work with the surface raceway system installed

2.4 PENETRATIONS

A. Sleeves Through Floors and Walls
1. All penetrations through floors or walls shall require a UL listed device for the purpose of penetrating the construction.
   a. Concrete, block, brick, and gypsum drywall construction providing a fire rating of greater than one hour for walls and floors will require a UL rated sleeve assembly installed to manufacturer's requirements allowing the penetration(s) to not degrade the designed fire rating of the wall or floor.
      1) Basis of Design: as manufactured by Unique Fire Stop Products (USFP). Utilize USFP's Threaded Penetrator system for all fire- rated penetrations.
   b. All other penetrations and gypsum drywall constructed walls providing a fire rating of one hour or less will require a UL rated sleeve assembly installed to manufacturer's requirements allowing the penetration(s) to not degrade the designed fire rating of the wall or floor.
      1) Basis of Design: as manufactured by Unique Fire Stop Products (USFP). Utilize USFP's Smooth Penetrator system for all fire-rated penetrations.
   c. All penetrations found to be improperly sleeved after the installation of cabling will be sleeved and firestopped to restore the proper aesthetics and required fire rating to the obstruction.
      1) Basis of Design: as manufactured by Unique Fire Stop Products (USFP). Utilize USFP's split-sleeve system for all fire rated penetrations.
2. Penetrations into fire rated walls with gypsum board construction.
   a. All penetrations required in gypsum board walls for installation of horizontal cabling, where conduit is not stubbed into the ceiling cavity for this purpose, will require a sleeved penetration through the drywall membrane or the wall cap.
      1) Each penetration will require a UL listed sleeve assembly installed by an installer trained on proper installation of the sleeving device.
      2) Basis of Design: as manufactured by Unique Fire Stop Products (USFP). Utilize USFP's Membrane Penetrator or Cap Penetrator system for all fire rated penetrations.
3. Basis of Design: Unique Fire Stop Products.
4. Additionally Approved: Field fabricated systems (inspected and approved by the code authority having local jurisdiction)

2.5 ACCESSORIES

A. Pull Strings
1. Pull strings shall be nylon type as manufactured by Arnco or approved equal.
2. Additional Approved Manufacturers: Greenlee, Condux

B. Fiber Optic Inner Duct
1. NEMA TC 5, UL listed, corrugated, specifically designed for optical fiber cable pathways.
   a. Color : Orange
   b. 1-inch minimum inside diameter
   c. 600 pounds minimum pulling strength
   d. Factory installed pull rope
   e. Rated for the environment in which it is installed.
   f. Riser Rated Environments:
      1) Basis of Design: Carlon DF4X1C-xxxx
   g. Plenum Rated Environments:
      1) Carlon CF4X1C-xxxx for installation in Plenum environments.
   h. Additional Approved Manufacturers: Arnco, Endot, Opti-Com, Pyramid

C. Cable Spillways
1. On 4-Inch Sleeves
   a. Cable Management Corp. Model CM-1004 Cable Spillway.
   b. Additional Approved Manufacturers: B-Line, Chatsworth
2. On 2-Inch Sleeves
   a. Cable Management Corp. Model CM-1002 Cable Spillway on two-inch sleeves.
   b. Additional Approved Manufacturers: B-Line, Chatsworth

D. Supports
1. General
   a. Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic.
   b. Products used outdoors shall be hot-dip galvanized.
2. Material Types
   a. Concrete and Masonry Anchors:
      1) Basis of Design: As manufactured Hilti, or approved equal.
   b. Raceway Supports:
      1) Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
   c. Fasteners:
      1) Types, materials, and construction features as follows:
         a) Expansion anchors: Carbon steel wedge or sleeve type
         b) Toggle bolts: All steel springhead type
         c) Powder-driven threaded studs: Heat-treated steel, designed specifically for the intended service
   d. Conduit Sealing Bushings:
      1) Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
   e. Cable supports for vertical conduit:
      1) Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits.
      2) Furnish with plugs with the number and size of conductor gripping holes as required to suit each individual application.
      3) Body construction: Malleable-iron casting with hot-dip galvanized finish.
   f. Threaded Rod Stock (All-Thread Rod)
      1) Available in ¼", 3/8", ½", and 5/8" sizes.
      2) Rod lengths over 6' will require a "Rod Stiffener" installation for ½" and 5/8" rods.

a) A section of U-Channel stock is placed around the rod and stiffener clamp assemblies used to clamp to rod.
b) Place clamps a minimum of 6" from the top and bottom of the rod and every 18" in between.
c) Basis of Design: B-Line SC228
Additional approved manufacturer(s):
Unistrut Diversified Products
GS Metals Corp.
Haydon, Corp.
Kin-Line Inc.

g. Slotted Met
1) 16-gauge steel channels, with 9/16 inch diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.
2) Basis of Design: Unistrut Diversified Products
3) Additional Approved Manufacturers: Allied Tube & Conduit, American Electric, B-Line Systems, Inc., Cinch Clamp Co., Inc., GS Metals Corp., Haydon Corp., Kin-Line Inc.

E. Bushing, Knockout Closures and Locknuts
1. Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate the layout and installation of raceway and boxes with the work of this and other Divisions; work of other trades; and with existing construction elements to ensure adequate headroom, working clearances, and to allow for post installation access.

3.2 INSTALLATION

A. General
1. Size all new pathways so as to ensure maximum fill ratios will not be exceeded when the systems cabling they serve is installed. Where drawings indicate the use of larger conduit sizes, install the larger sizes as indicated.
2. Install above-grade raceways, and cable tray parallel to and/or perpendicular to building elements.
3. Install pathways level, except where elevations changes are required for installation.

B. Raceways
1. Except as otherwise noted and/or detailed on the drawings, install the following types of raceways as defined below
a. Rigid Galvanized Steel (GRC):
1) Above grade, outside the building envelope, in exposed areas.
2) Above grade, inside the building envelope, in high moisture areas.
b. Electric Metallic Tubing (EMT):
1) Within the building envelope.
c. Polyvinylchloride (PVC):
1) Below grade (except where otherwise noted on the drawings).
d. Flexible Metal Conduit (FMC):
1) Flexible metal conduit shall only be used between a secondary pathway and a device location and shall only be used where it is expressly indicated on the drawings.

2) Maximum length of any FMC path shall not exceed 6 meters.

2. Conduit
   a. Install all conduit terminations with locknuts and bushings. Provide conduits 1 ½ inches and larger with insulating bushings and locknuts inside and outside the enclosure.
      1) At least one bushing per conduit shall be grounding type, equipped with a grounding lug.
      2) Ground conduit system required by code and in accordance with the grounding and bonding specifications and related drawings.
   b. Support conduits by pipe straps or trapeze hangers. Space supports not more than 8 feet on center. Secure supports by means of toggle bolts, inserts or expansion bolts.
   c. Space wall brackets supporting conduits not more than 4 feet 6 inches on center. Secure supports by means of toggle bolts, inserts or expansion bolts.
   d. Support raceway components directly from structural building systems, not from ceiling suspensions systems. Provide supplemental supports for junction or pull boxes.
   e. Conceal conduit raceways under floors, in walls, above ceilings and in furred spaces within finishes building areas.
   f. Support single conduits 1 ½ inches and larger by means of rod and cast ring hangers. Support multiple runs in similar manner or use common trapeze hanger.
   g. Provide two-hole sheet metal pipe straps for all surface mounted conduit supports on walls up to a height of 8 feet above the finished floor.
   h. Pinch type hangers similar to minerallac type shall only be used at heights greater than 8 feet.
   i. Protect conduits during construction with temporary plugs or caps.
   j. Securely cap all conduits until wire or cable is installed. Do not install conduit in concrete slab.
   k. Provide expansion fittings where raceway crosses the building expansion joints. (O.X. Type AX, EX, EXDS, TX, EXE, or approved equal).
   l. Conduit Routing
      1) If specific routing information appears on the drawings, route and maintain conduits as shown. Should interference or conflict arise, the Contractor shall inform the Designer before proceeding with the Work.
      2) If specific routing information does not appear on the Drawings, Contractor shall determine the best route for the conduit in accordance with code and other specified guidelines.
   m. Conduit bends
      1) Bends shall be made so that the conduit will not be flattened or kinked and the internal diameter of the conduit will not be reduced.
      2) The radius of the curve of the inner edge of any bend shall not be less than as indicated by the National Electrical Code and ANSI/TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces.
      3) In no case shall any conduit be bent or shall any fabricated elbow be applied to less than the allowable bending radius as specified by the cable manufacturer of the installed conductor.
      4) When necessary to make field bends, use tools designed for conduit bending.
         a) Heating of metallic conduit to facilitate bending is not permitted.
      5) Constructing an outside entrance to a building from buried conduit to penetrate above the ceiling line will allow an exception for a 4” LB fitting at one end to allow placement of the conduit flat to the building outside wall.
   n. The Contractor shall not cut, burn, or drill any structural member to mount electrical equipment or to facilitate tray or conduit installations without having previously received approval, in writing, from the Architect/Engineer/Consultant.
   o. Install above-ceiling conduits a minimum of 7 inches above ceiling tiles so as to permit ceiling tile removal
   p. Install conduits at least 6 inches from insulated pipes, steam lines or any other hot pipes they pass. Where the lines are not insulated, the clearances shall be increased until the temperature of the conduit, with no live conductors enclosed, does not rise above the ambient temperature of the installation area.
   q. Conceal all raceways except where otherwise indicated.
   r. Install flashing and counter flashing or pitch pockets for waterproofing of all raceways, outlets, fittings, etc. that penetrate the roof.

s. Install sleeves in forms for new concrete walls, floor slabs, and partitions for passage of raceways.
1) Seal sleeves in an approved manner that pass through fire rated walls, floors, and ceilings, following raceway installation.
t. Waterproof all sleeved raceways in areas prone to high moisture and condensation.

3. Surface Raceway
a. Install surface raceway in areas indicated on drawings.
b. Coordinate installation with casework prior to the installation of casework and raceway.
c. Install raceway, accessories and device boxes plumb and level.
d. Anchor raceways to walls with the anchors designed for the wall construction encountered.
e. Secure raceway at intervals of not more then 2 feet, and not less than 6 inches from the ends of each raceway.
f. Install raceway per the manufacturer's written recommendation, including necessary entrance, ending and bend fittings.
g. Furnish and install all of the manufacturer's recommended fittings and accessories.
h. Where surface raceway is provided for a secondary pathway from the outlet to the ceiling space, extend surface raceway into the ceiling space not less than 4 inches.

4. Pull Boxes
a. Install all pull boxes as indicated on the drawings.
b. Install pull boxes every 180 degrees of conduit bends
c. Install pull boxes within the building every 100 feet of conduit.
d. Install pull boxes for underground conduits at intervals not more then 600 feet of conduit. Install more frequently as required by Code.
e. Install pull boxes in areas that will be accessible after installation.
1) Accessible areas include above accessible ceiling, snap-in ceilings, and behind access doors.
f. Support and size boxes in accordance with the N.E.C.
g. Land conduits on the box so conduit entry will permit the longest radius for conductors contained therein.
h. Provide junction and pull boxes such that conduits enter and exit across from each other on opposite sides of the junction box.
i. Do not use pull boxes in lieu of conduit bends.

C. Pull Stings
1. Install a usable pull string in every pathway prior to the installation of cables.
2. This string shall be used to aid in the installation of system cables.
3. Install a usable pull string each pathway during the installation of cable(s) within the pathway. This string be tied off and shall remain available for future use.

D. Inner Duct
1. Install appropriately sized inner duct in all pathways that will be used to enclose and support fiber optic cables.
a. Inner duct is not required in those pathways containing exclusively Armored-type fiber optic cables.
2. Plenum rated inner duct shall be used in pathways that are not 100% conduit.

E. Spillways
1. Install cable spillways where cabling exits a conduit sleeve, cable tray, etc. where cable(s) will be unsupported for more than six inches.

F. Telecommunications / Power Poles
1. Mount straight and anchor to building structure above the ceiling line.
2. Provide mounting hardware, entrance end fitting, and ceiling trim plate.
3. Coordination and Positioning
a. Coordinate positioning with other trades to assure maximum accessibility.
1) Tray shall be mounted securely along the wall at a minimum of 6" (lower tier) above the ceiling line.
2) Where two 12" trays connect to a two tier unit, the upper tray may continue at 12" (upper tier) above the accessible ceiling.

3) Where tray cannot be wall mounted, (transversing hallways, etc.) mount span securely to wall at each end and provide ½" threaded rod supports, anchored into the concrete deck above, every 4' at minimum.
4) Minimum access should be 12 inches clear above the tray (each tier) and 12 inches clear beside the tray to facilitate moves, adds and changes for telecommunications cabling.

G. Discreet Cable Supports (J-Hooks)
1. Discrete cable supports shall be installed to support cables in areas that are readily accessible after installation (example: above accessible suspended ceiling).
2. Enclosed raceways systems shall be used in lieu of discrete cable supports where cables must pass through inaccessible areas.
3. Install separate supports for cables from every system, and install separate supports for incompatible cables from the same system. Array supports vertically using the appropriate spacing.
4. Attach supports directly to vertical building surfaces, or from overhead structural members using threaded rod and other approved attachment methods.
5. Install supports plumb and square.
6. Mount bottom of supports approximately 12" above suspended ceilings.
7. Cable supports shall be installed at intervals not exceeding 5' feet.
8. Adjacent supports shall be installed at the same elevation except where necessary for coordination with other trades and pathways of other systems.
9. Install supports so that they do not interfere with the ability to remove ceiling tiles.
10. Support with threaded rod and U-channel supports systems.
11. Discrete Support Sizing and Quantity
    a. Do not exceed 75% of the permissible fill capacity of any support provided.
    b. Install multiple supports as required to handle the total quantity, size and type of cables served.
    c. After installation of cables, 25% of rated permissible fill capacity shall be reserved of future use.
12. Discrete Support Usage and Quantity
    a. Use separate supports for cables from difference systems
    b. Use separate supports to carry cables of incompatible signals from the same system.

H. Device Boxes
1. New-work and old-work device boxes shall be installed flush with or slightly recessed below the finished surface (but no more then code allow, nor more then .078-inches (2mm)). Old work boxes require advanced craftsmanship and construction techniques to achieve this.
2. Installed height of boxes shall generally be as indicated on the drawings. Installed heights shall be adjusted in the field to ensure a clean appearance that results from coordinating with existing installed box heights and new boxes being installed to serve non-communications systems. Where the specified box height and existing condition boxes differ by more then 2-inches, seek the direction of the Designer prior to installation.
3. Device boxes and their associated cover plates shall not span different types of wall finishes either vertically or horizontally. Horizontal and vertical position of boxes shall be adjusted at time of installation to ensure that this condition does not exist after installation.
4. Boxes in masonry shall be installed so that the specified over plates will cover the mortar joints and cut openings completely.
5. Device boxes shall be installed so that they are securely and rigidly attached to the building by any of the following methods:
    a. Double bar installation for metal stud walls. Bar hanger punch, mounting clips, and retainer clips shall be used in strict accordance with manufacturer's instructions. Factory pre-punched stud holes shall not be used to support the bar hangers.
    b. Steel stud installed behind box for support without "caddy-type" mounting clips for metal stud wall construction.
    c. "Caddy-type" screw gun bracket installed behind box for support. Installation shall be per manufacturer's instructions.
6. Devices boxes shall not rely on the raceway as their primary means of support. Boxes shall be attached to surrounding building structure.
7. Device boxes shall be installed plumb and level, held to within all of the following limits:
    a. Maximum one-tenth (1/10) of one degree from plumb and from level, and;

b. Maximum difference from level of .078-inches (2mm) at one end of the box relative to the other end of the box, and;
c. Maximum difference from plumb of .078-inches (2mm) at the top of the box relative to the bottom of the box;

8. Boxes shall be shimmed as necessary to insure level and plumb installation.
9. Install gaskets on all boxes installed outside and in wet or damp locations (tunnels, crawlspaces, pits, etc.).
10. Device boxes shall be protected from plaster.
11. Floor boxes shall be installed flush and true with the finished floor.
12. Boxes shall be cleaned of debris after installation.
13. Boxes shall be cleaned of debris thoroughly prior to installation of cover plates;
14. Install blank cover plates on each unused device box.

I. Penetrations
1. Sleeves Through Floors and Walls
a. Install conduit sleeves where indicated on the drawings and wherever cables or raceways will pass through floors, walls, ceilings, and any concrete or masonry structure, except where tunnels, chases or shafts are provided in the project site construction.
1) Sleeves through poured-in-place concrete surfaces shall be set in place prior to the concrete pour and shall be of a design that seals against the passage of water between the sleeves and concrete floor.
b. Install cable protecting bushings on the each end of each sleeve.
c. Extend all through-the-wall sleeves a minimum of 2 inches beyond the wall surface, longer as required, to allow installation of conduit bushings.
d. Extend through-the-floor sleeves 4 to 6 inches above finished floors, except where otherwise noted on the drawings.
e. Voids between the sleeve and the building surface shall be neatly finished and filled with approved fire stop material.
2. Labeling
a. Install penetration certification next to each penetration through fire-rated surfaces.

J. Supports
1. Fabricated Supporting Devices
a. Conform to the manufacturer's recommendations for selection and installation of supports.
b. The strength of each support shall be adequate to carry present and planned future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs. provide additional strength until there is a minimum of 200 lbs. safety allowance in the strength of each support.
c. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
d. Support parallel runs of horizontal raceways together on trapeze-type hangers.
e. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners shall be used in lieu of hangers for 1 ½ inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only.
f. For hanger rods with spring steel fasteners, use ¼ inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
g. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings shall be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
h. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
2. Miscellaneous supports
a. Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, pull boxes, junction boxes, and other devices.

b. Support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

3. Fastening:
   a. Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to; conduits, raceways, cables, cable traps, busways, cabinets, panel boards, transformers, boxes, disconnect switches, and control components in accordance with the following:
      1) Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts shall be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
      2) Holes cut to depth of more than 1 ½ inch in reinforced concrete beams or to depth of more than ¾ inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
      3) Ensure that the load applied to any fasteners does not exceed 25 percent of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.
   b. Raceway supports: Hanger spacing shall be as required for proper and adequate support of the raceway, but in no case shall be less than one hanger per 5 feet of raceway length.

K. Ground and Bonding
   1. Ground and bond raceway systems in accordance with the NEC and ANSI/TIA/EIA 607. See Related Drawings and Specifications for additional information.

3.3 TRAINING

A. Review the pathway system(s) with the Owner's facility management personnel, and other owner designated personnel responsible for ongoing maintenance of systems installed within the pathways.

B. Review all key pathway paths and expansion capabilities

END OF SECTION 27 05 28

SECTION 27 05 53

IDENTIFICATION FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Labeling of Communications Systems, Equipment and Rooms
   2. System includes but is not limited to:
      a. Communications product identification labels
      b. Communications room labels
      c. Communications Key Drawings

1.2 REFERENCES

A. ANSI/TIA/EIA-606 – The Administrative Standard for the Telecommunications Infrastructure of Commercial Building.

B. "TELECOMMUNICATIONS DISTRIBUTION METHODS MANUAL" published by the Building Industry Consulting Services International (BICSI).

1.3 SYSTEM DESCRIPTION

A. Identification of Communications shall consist of professionally created and applied labeling products for the following types of Communications products.
   1. Cabling
   2. Equipment racks
   3. Equipment enclosures
   4. Patch panels
   5. Device plates
   6. Communications equipment room(s)
   7. Communications cabling, including horizontal and backbone cabling
   8. Communications cabling cross-connects
   9. Communications backboards

B. The labeling schema used for structured cabling shall be an ANSI/TIA/EIA-606 compliant system - The Administrative Standard for the Telecommunications Infrastructure of Commercial Building Identification System. See Related Drawings for graphical representation.

C. Each communications room shall be equipped with a set of unique Key Drawings that shall identify the installed location of communications devices served out of and interconnected to the communications room. The drawings shall include identifiers that uniquely associated field devices with specific termination products within the Communications room.

1.4 SUBMITTALS

A. General
   1. Product Data and Shop Drawing submittals for work of this section shall be SUBMITTED TOGETHER, complete, as a single submittal.

B. Product Data
   1. Manufacture datasheets for all products.

C. Shop Drawings
   1. Labeling system diagram, detailed.
   2. Communications room wall elevation drawings indicated the size, title and location of all Key Drawings.

D. Communications Room Key Drawings
   1. (2) full size copies of the Communications Room Key Drawings
      a. These drawings should be submitted for review by the Designer with or prior to the pre-acceptance submittal.

E. Closeout Submittals
   1. A diagram of the labeling schema used on the Project.
   2. Copies of Communications Room Key Drawings

PART 2 - PRODUCTS

2.1 GENERAL

A. All products used for labeling and identification of communications systems shall be reviewed and approved by the Designer prior to installation.

2.2 MANUFACTURERS

A. Products equal to the Basis of Design products from the following manufacturers may be used on this project:
   1. Panduit
   2. Hellerman/Tyton
   3. Brother
   4. Thomas and Betts

2.3 LABELS

A. Cable Labels
   1. Cable labels shall permanent, self laminating type.
   2. Labels shall have a white background for text, and bold black nomenclature.
   3. Provide alphanumeric, clearly typewritten labels at all designated points as follows:
      a. Horizontal Cables
         1) 4 pair UTP cables
            a) Basis of Design: Brady PTL-31-642
         2) 4 pair STP cables
            a) Basis of Design: Brady PTL-21-642
         3) Coaxial cables
            a) Basis of Design: Brady PTL-31-642
      b. Backbone cables
         1) 100 pair Copper cables
            a) Basis of Design: Brady PTL-34-642
         2) Fiber Optic Cables
            a) Basis of Design: Brady PTL-21-642
         3) Cable Bundles
            a) Basis of Design: Brady PTL-12-109

B. Miscellaneous Product Labels
   1. Telecommunications outlet port
      a. Basis of Design: Panduit PLL-46-Y2-1
   2. Telecommunications outlet faceplate
      a. Basis of Design: Panduit JLEFPS-1
   3. Patch panel ports
      a. Basis of Design: Panduit JLCPL-1
   4. Patch Panels
      a. Basis of Design: Brady PTL-20-422
   5. 110 style blocks
      a. Basis of Design: Panduit DSL-110
      b. Use with Panduit P110LH
   6. Communications Backboards
      a. Basis of Design: Brady PTL-37-422
   7. Racks and Cabinets
      a. Basis of Design: Brady PTL-42-422

2.4 KEY DRAWINGS

1. Key drawings shall be professional produced by the Contractor.
2. Drawings shall be produced to include floor plans drawing to scale, typically at 1/8-inch = 1-foot, unless otherwise approved by the Designer.
3. Key drawing size shall be in direct proportion to the size of the space represented, but in not case larger than 24-inches by 36-inches.
4. Drawings shall be prepared on a 20lb bond paper substrate.
5. The key drawing information shall be produced in color. The color scheme shall be as follows.
   a. Paper background: White
   b. Floor plan layout: Light gray / faded black
   c. The colors of all drawing system associated with each system shall be unique.
6. Key Drawing Protective Overlay
   a. 1/8” Clear Plastic
   b. Size: 2-inches wider and 2-inches taller than the key drawings it protects.
   c. Pre-drilled with mounting screw clearance holes
      1) Mounting holes shall be place 1/2-inch from the overlay edge and1/2-inch from the drawing the overlay protects.
      2) Mounting holes shall exist in each corner of the overlay
      3) Mounting holes shall exist along the vertical and horizontal edges, uniformly spaced no more than 18-inches on center.
7. Key drawings shall be prepared for each system and for each Communications room.
8. All key drawings shall have the same quality appearance. Colors, font type and properties shall be consistent and shall appear as though they were all prepared by the same professional organization.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Labels

   1. General
      a. Apply all labels so that they are installed parallel to the dominant visual lines of the product being labeled.
      b. Labels shall be clearly legible and appropriately sized for the application.
   2. Cable Labels
      a. Horizontal structured cabling:
         1) Cabling to ER/TR from outlets and devices
            a) ER/TR # - Patch Panel #/Port # - Outlet Room Number.

b) Example: ER01-211-B22 where Equipment Room is identified as ER01, the cable travels to room 211 and the cable is landed on patch panel B position 22 (of 48) in the ER.
c) Locate label on cable jacket between 3 and 6 inches of each end of the cable.

2) Cabling between horizontal outlets/devices
a) Label local input cables.
b) Locate label on cable jacket between 3 and 6 inches of each end of the cable.
c) Label each cable as to its signal type, purpose, and destination. Add a numeric suffix to uniquely identify multiple cables of duplicate signal type, purpose or destination.

3. Miscellaneous Product Labels
a. Telecommunications outlet ports and faceplates:
1) ER/TR# - Outlet Room Number – Patch panel #/ Jack #.
2) Example: ER01-211 faceplate number and B22 through B25 jack numbers for a 4 port faceplate where Equipment Room is identified as ER01, the cable is landed on patch panel B position 22 through 25 (of 48) in the ER and travels to room 211.
3) Locate the faceplate label, excluding the jack designation at the top of the faceplate. Locate the individual jack designation numbers immediately above each jack on the faceplate.

b. Patch panels and patch panel ports:
1) Label each patch panel A-Z, top-to-bottom
a) Locate label on the front upper left corner of all patch panels
2) Locate on the front of all patch panels, directly above or below (as indicated by the manufacturer) each jack position (1 through 48) in the patch panel; place the room number corresponding to the room number used on the faceplate for each port.
3) Labeling shall be in numerical order and correspond to the telecommunications outlet faceplate schema.

c. Backbone cabling:
1) Service designation – ER#/TR#.
2) Service designation – CB = Copper Backbone, FB = Fiber
3) Backbone, VB = Video Backbone. Example: CB – ER01/TR02.
4) Locate label on cable jacket within 6 inches of each end of the cable and at key pull points along pathway.

d. Cross-connect blocks, 110 style
1) Locate on the front of all blocks directly above or below (as indicated by the manufacturer) each position in the block.
2) Labeling shall be in numerical order and correspond to the telecommunications outlet faceplate scheme or opposite end labeling dependant on use.
3) Label the upper left corner of each block designating the service of that particular block. Do not terminate mixed services on the same block.

e. Cross-connect blocks, 66 style
1) Locate on the front of all blocks directly above or below (as indicated by the manufacturer) each position in the block.
2) Labeling shall be in numerical order and correspond to the telecommunications outlet faceplate scheme or opposite end labeling dependant on use.
3) Label the upper left corner of each block designating the service of that particular block. Do not terminate mixed services on the same block.

f. Communications Backboards (TBB)
1) Backboard # with the prefix TBB, followed by the numeric backboard number in the room, followed by the suffix identifying the room in which the backboard is located. Example: TBB–01- ER-xxx.
2) Label each 4’x8’ sheet and each partial sheet, in numerical order left-to-right as facing the front of the backboards.

g. Equipment Racks
1) Device ID. Example: ER01.02.
2) Label each cabinet/rack in numerical order left-to-right as facing front of cabinet/rack bays.

h. Telephone Patch Cables
1) Labeled with the same unique identifier at both ends of the assembly.

B. Key Drawings
1. Install Key drawings within each Communications room.
2. Create and install separate drawings, for each system. Voice and data systems may occupy the same key drawing.
3. Install key drawings where they will be readily accessible, visible and legible by Owner personnel.
a. Normally, drawings shall be installed so that the top edge of the drawing(s) is at 72-inches above finished floor. If this height is not achievable the Contractor shall make recommendations to and seek the direction of the Designer.
4. Separate Key Drawings shall be prepared for each system, including but not limited to:
a. Voice (Telephone) and Data (Network) communication systems RF Broadband Video Distribution Systems (CATV/SMATV/MATV)
b. Security Systems (Video Surveillance, Access Control, Intrusion Detection, etc…)
c. Other systems as specified in this Division.

3.2 TRAINING

A. Conduct a walk through of the project site and demonstrate the presence and location of all key labeling elements used.

B. Demonstrate the accuracy of these Key drawings to the Owner by having the Owner randomly select devices on the key drawings followed by this Contractor showing the physical location and coordinated labeling of the actual field devices.

C. Furnish handouts to all owner personnel attending training that clearly depicts the labeling schema used on the project.

END OF SECTION 27 05 53

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SECTION 27 11 16

COMMUNICATION CABINETS, RACKS, FRAMES AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Supply and installation of equipment racks, cabinets, frames, enclosures and related accessories.

1.2 DEFINITIONS

A. Where the term “Equipment Rack”, or “Rack”, in either it’s singular or plural form, as utilized within this specification(s) and on the drawings is intended to generically refer to products designed for and normally used to house and/or mount 19”, 23” and 25” E.I.A. standard “rack mounted” equipment. These “Racks” come in multiple forms, sizes, styles and finishes including but not limited to the following:
1. Cabinet Types
2. Open Frame/Relay Types
3. In-Wall Types
4. Wall Mounted Types
5. Swinging Types
6. Portable and Roll around Types
7. ATA Types
8. Miscellaneous specialty types

1.3 SUBMITTALS

A. General
1. Product Data and Shop Drawing submittals for work of this section shall be SUBMITTED TOGETHER, complete, as a single submittal.

B. Product Data
1. Complete Bill of Materials (BOM) List
   a. The BOM shall be organized (i.e. “sub-grouped”) by Device ID.
   b. Under each Device ID the Contractor shall enumerate the quantity, brand and model of every product to be supplied associated with each Device ID.
   c. The manufacturer’s name (Brand) and full model number shall be used. (Distributor and Contractor assigned names and model numbers are unacceptable).
   d. Adjacent to the Device ID the Contractor shall clearly indicate the following:
      1) The Rack Type (as identified within these specifications)
      2) The room name and number in which the rack is to be located.
      3) The system(s) that the rack supports
2. Manufacturer Product Datasheet for each product.
   a. Product datasheets shall be manufacturer originals, or first generation printed versions of manufacturer’s official electronic product sheets.
   b. Manufacture model shall be highlighted on each sheet.
   c. Datasheets shall be organized to match the order and organization of this section

C. Shop Drawings

1. ½" = 1'0" enlarged plans of each space that houses one or more equipment rack(s) and related accessory products. Seek the direction of the Designer if a scale other then this is necessary to make the plan(s) fit on the specified sizes of paper.
   a. Drawings shall be reproduced on 11" x 17" paper,
      1) Drawings shall be reinforced, folded and bound into the rear of the submittal binder.
      2) Each drawing shall reflect a single room.
   b. Drawings shall clearly reflect the unique Device ID assigned to the rack.
2. Full Scale drawings of the labels that will be affixed to each equipment racks.

D. Quality Assurance / Control Submittals
1. RCDD Certification for the staff member responsible for this project.
2. Resume of the last 10 projects of the RCDD responsible for this project
3. BICSI Technician's certificate for each lead Technician(s) on the project

E. Closeout Submittals
1. Communication Room enlarged Floorplan Layouts, drawing to scale, depicting device sizes and locations..
2. A diagram of the labeling scheme used on the Project.

1.4 DELIVERY, STORAGE AND HANDLING

A. This contractor shall coordinate the delivery location and timing of delivery of product to the project site and/or other contractor's pre-assembly site(s) as necessary to meet the needs of contractors utilizing product supplied under this section.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. General
1. All racks shall be UL Listed for the location and manner in which the product will be installed and used.
2. All products furnished of a given type under this section shall be manufactured by a single manufacturer; shall bear the same brand name; shall be of the same finish color and texture; and shall be from the same product model series, unless otherwise noted.
3. Accessories furnished for use with an equipment rack shall be from the same manufacture as the rack, except where unless otherwise specified and/or indicated on the drawings
4. All equipment racks and their accessories shall be furnished black in color unless otherwise expressly identified herein or noted on the drawings.
5. All racks located adjacent to one another shall be matching in size, color, fit and finish texture, and shall be manufactured by the same manufacturer except where otherwise expressly required by the Designer.
6. All racks located within eye-sight of one another shall be matching in color, finish texture, and as manufactured by the same manufacture except where otherwise expressly required by the Designer.

B. Substitute Racks
1. Substitute equipment racks may not exceed the physical dimensions of the specified equipment racks, nor may they be less then ½ inches less in any external dimension without the model specific pre-bid written approval of the Designer.

C. Rack Side Panels
1. Where equipment racks require accessory side panels, and where these racks are detailed on the drawings to be "ganged" together, only one set of side panels is required to be furnished for each model of rack in the gang.

2.2 EQUIPMENT RACKS

A. Floor Type
  1. Description
    a. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
    b. Material: Extruded aluminum.
    c. Four-post: minimum 1000lbs load rating.
    d. Overall height: as shown on drawings.
    e. Depth: minimum 23 inches.
    f. Rack units: as shown on drawings.
    g. Finish: Manufacturer's standard, baked-polyester powder coat.
      a) Color: Black.
    h. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug and power distribution units (PDU).
    i. Base shall have a minimum of four mounting holes for permanent attachment to floor.
    j. Top shall have provisions for attaching to cable tray or ceiling.
      a) Self-leveling
    k. Approved Manufacturer: Panduit.
    l. Additional approved manufacturer(s): Great Lakes, Chatsworth, Hubbell.

2.3 RACK ACCESSORIES

A. Storage Drawer
  1. Accessory key lock.
  2. Sizes and quantity as indicated and/or scaled from drawings.

B. Filler Panels
  1. General
    a. Provide quantity of filler panels as required to filling all unused spaces of every supplied equipment rack not occupied by a supplied product specified in another section or as shown on the Detail Drawings.
    b. Except where shown on the drawings, all furnished filler panels shall not exceed 2-rack units (3.5 inches) in height.
    c. Provide appropriate mixture of vent-type and blank-type filler panels as required to ensure proper air-flow and equipment cooling.
  2. Vent-Type
    a. 16-Gauge steel construction
    b. Vertical vent slot orientation
    c. Textured powder coat finish
    d. Flanged upper and lower edges for rigidity.
  3. Blank-Type
    a. 16-Gauge steel construction
    b. Textured powder coat finish
    c. Flanged upper and lower edges for rigidity.

C. Rack Mount Shelves – (for use in Voice/Data/Network Racks only)
  1. Basis of Design: Homaco ESV-19-4B
  2. Sizes and quantity as indicated and/or scaled from drawings.

D. Rack Mounted Shelves – Custom (used for Audio, Video and Security Systems Equipment)
  1. 16-Gauge steel construction
  2. Textured powder coat finish
  3. Form-fitted front panel sized to exactly match the products hosted on the shelf
  4. Custom sized in standard EIA Rack unit heights to match the equipment hosted on the shelf.
  5. Quantity: Furnish quantity and size of custom shelves required to accommodate all equipment to be mounted that is neither supplied with nor available from the product manufacturer with a rack mount accessory kit.

E. Rack Mounting Screws
   1. Truss-type screw head
   2. Black finish
   3. Matching size and color nylon protective washer
   4. For Racks with #10-32 threaded rack rails
      a. #10-32 thread
         1) Furnish (3) Phillips-drive screw/per rack space/per supplied rack.
         2) Furnish (1) Square-post security drive screw/per rack space/per supplied rack.
   5. For Racks with #12-24 threaded rack rails
      a. #12-24 thread
         1) Furnish (4) Phillips-drive screw/per rack space/per supplied rack.

2.4 LABELS

A. Equipment Racks
   1. Label shall be white polyester.
   2. Label shall have temperature range of -40 to 248 degrees F
   3. Label shall have superior adhesion and utilize thermal transfer
   4. Label shall utilize ¾" black font
      a. Basis of Design: Brady PTL-100-483

PART 3 - EXECUTION

3.1 COORIDINATION

A. This Contractor shall coordinate closely with all Contractors/sub-contractors/vendors supplying work within supplied product. This coordination shall include review of equipment rack configurations to ensure that they appropriately complement the systems being supplied;

B. This Contractor shall coordinate the delivery of product and its installation to meet the workflow of contractors, sub-contractors and this project as a whole.

3.2 INSTALLATION

A. Equipment Racks
   1. General
      a. Secure all fixed position, non-portable equipment racks using removable threaded fasteners to prevent equipment racks from movement and tipping over.
      b. Bond all equipment racks to the Telecommunications System Ground.
      c. Properly secure racks to the floor allowing a minimum of 36-inches of clearance from the rear of the rack to the rear wall except where otherwise expressly dimensioned on drawings.
      d. Install rack doors and panels.
   2. Cabinet Types
      a. Install bushings or grommets to protect cables where exiting or entering the rack. Clean, prep and paint visible conduits using oil-based paint that exactly matches color of equipment rack.
   3. Open Frame/Relay Types
      a. Install bushings or grommets to protect cables where exiting or entering the rack. Clean, prep and paint visible conduits using oil-based paint that exactly matches color of equipment rack.
   4. Swinging Cabinet Types
      a. Furnish and install minimum of two (2) 3-inch conduits stubs from top of cabinet back pan to cable tray, ladder rack and/or accessible ceiling above for cabling. Provide additional quantities and sizes as indicated on drawings. Install insulated throat bushings to protect

cables. Clean, prep and paint visible conduits using oil-based paint that exactly matches color of equipment rack.

5. Wall Mounted Types
   a. Furnish and install minimum of two (2) 3-inch conduits stubs from top of cabinet to cable tray, ladder rack and/or accessible ceiling above for cabling. Provide additional quantities and sizes as indicated on drawings. Install insulated throat bushings to protect cables. Clean, prep and paint visible conduits using oil-based paint that exactly matches color of equipment rack.
6. Portable Types; Racks with Casters
   a. Install insulated throat bushings to protect cables entering rack and other cable penetrations.

B. In-Ceiling Zone Cabling Enclosures
1. In-ceiling consolidation points shall be designed to fit in 2'x2' drop-ceiling grid.
2. Enclosure shall be supported from building structure above lay-in ceiling grid and be installed to manufacturer's instructions.
3. Enclosure shall be capable of mounting at least 9 RU of equipment/panels.
4. Basis of Design: Panduit CICZC2X2 with CICZCBRKT
   a. Additional approved manufacturers: American Access Technologies, Chatsworth Products

C. Rack Accessories
1. Grounding Bus Bar
   a. Install grounding bus bars in each equipment rack
2. Filler Panels
   a. Install the required size and type of filler panels in equipment racks.
   b. The size, location and ratio of blank–to-vent filler panels shall be as required to assure proper ventilation of equipment.
   c. Mount the filler panels within the rack using approved mounting hardware, ensuring that all unused spaces within the equipment rack are covered.
3. Rack Lights
   a. Supply and mount service lights in the rear of all equipment racks.
   b. Where non-magnetic racks are supplied, supply and install Designer approved substitute fixture attachment hardware.
4. Rack Drawers
   a. Furnish and install rack drawers as indicated on the drawings.
5. Ventilation Products
   a. Furnish and install ventilation products as specified and indicated on the drawings. Test operation of all ventilation products and adjust as appropriate
6. Cable Management Products

3.3 LABELING

A. Label all equipment racks in accordance with Division 27 – "Identification for Communications"

END OF SECTION 27 11 16

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SECTION 27 11 23

COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Supply and installation of complete and working cable management system(s) for use within communications rooms. Work includes, but is not necessarily limited to:
      a. Specialty cable management and support products used to dress, support, store and organize cables mounted to walls and ceilings.
      b. Horizontal and vertically oriented ladder rack used for support and management of cables.
      c. Horizontal and vertical cable management used within equipment racks.

1.2 SYSTEM DESCRIPTION

A. The cable management and ladder rack system shall accommodate the support and orderly routing and management of communications and related cabling with communication rooms.

B. The system shall consist of horizontal ladder rack used for support of cables that need to traverse horizontally overhead within the room.

C. The system shall consist of vertical ladder rack for support and dressing of cables that must traverse vertically from cable entry/exit points near the floor upwards towards the ceiling and/or to entry/exit points near the ceiling of the room.

D. The system shall consist of horizontal and vertical cable management products used to support and dress cables that land on products mounted to the walls and/or ceilings.

E. The system shall consist of horizontal and vertical cable management products used for management of communication cable products within an equipment rack

1.3 SUBMITTAL

A. General
   1. Product data and shop drawing submittals for work of this section shall be submitted together as a single submittal.

B. Product Data
   1. Bill of materials list
   2. Manufacture datasheets for all products and accessories

C. Shop Drawings
   1. Communication room enlarged floor plan(s) depicting all of the following:
      a. Sizes and locations of all ladder rack
      b. Sizes and locations of other cable management products
      c. Drawings shall be on 11x17 paper.
   2. Communication room(s) wall elevations depicting all of the following:
      a. Sizes and locations of all ladder rack

b. Sizes and locations of other cable management products
c. Drawings shall be on 11x17 paper.

D. Closeout Submittal
1. Datasheets for all products used.
2. Bill of materials list of products used in each communications room.
3. Scaled and accurate as-built shop drawings.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Ladder Rack
1. Horizontally mounted
a. Constructed of 1 ½ inch by 3/8 inch ASTM A513 compliant tubular steel
b. Black in color.
c. Dimensions shall be 12 to 24 inches wide (as indicated on the drawings) with 9 to 12 inch spacing between cable support rungs.
d. Horizontally installed ladder rack shall have 7-inch high posts spaced every two feet on center.
e. Basis of Design: Chatsworth 10250-712
f. Additional Approved Manufacturers: Homaco, PFT, B-Line/Saunders
2. Vertically mounted
a. Constructed of 1 ½ inch by 3/8 inch ASTM A513 compliant tubular steel
b. White in color. (Matching white backboard)
c. Ladder rack dimensions shall be 12 to 24 inches wide (as indicated on the drawings) with 9 to 12 inch spacing between cable support rungs.
d. Basis of Design: Chatsworth 10250-212
e. Additional Approved Manufacturers: Homaco, PFT, B-Line/Saunders
3. Spillways, Waterfalls, Cable Drop-outs
a. Basis of Design shall be Chatsworth 12100-xxx.
b. Additional approved manufacturers: Cooper/B-Line, Hoffman, Homaco, Middle Atlantic

B. Voice/Data Rack Cable Management
1. TYPE A (All Cable Management panels shall be of this type unless specifically noted as another type on the detail drawings.
a. Cable Management panels shall provide station cable routing on the rear and both horizontal and vertical metal slotted rings, and plastic wire holding clips on the front.
b. Basis of Design:
1) 2 Rack Space units:

WIRE MGMT PANEL	WM-A(2RU)		
	Basis of Design	Additional Approved Prod-uct	Additional Approved Prod-uct
Manufacturer:	HOMACO	MIDDLE ATLANTIC	HUBBELL
H/W Inches:	3.5/19"	3.5/19"	3.5/19"
Panel	HFM-19-2	HCM-2DR	HC219GC36
Vert.Cable Mgmt Rings:	INCL	(2) D-RING	(2) HC23VR2
Front Cord Rings:	INCL	INCL	INCL
Rear Cable Channel		INCL	INCL

2) 1 Rack Space units:

WIRE MGMT PANEL	WM-A(1RU)		
	Basis of Design	Additional Approved Prod-	Additional Approved Product

		uct	
Manufacturer:	HOMACO	MIDDLE ATLANTIC	HUBBELL
H/W Inches:	1.75/19"	1.75/19"	1.75/19"
Panel	HFM-19-1SR	HCM-1DR	HC119GC36
Vert.Cable Mgmt Rings:	INCL	(2) D-RING	(2) HC23VR2
Front Cord Rings:	INCL	INCL	INCL
Rear Cable Channel	INCL	INCL	INCL

2. TYPE B (Shall be used when mounting in a Cabling Cabinet with Vertical Management installed)
   a. Cable Management panels shall provide station cable routing on the rear and horizontal metal slotted rings, and plastic wire holding clips on the front.
   b. Basis of Design:
      1) 2 Rack Space units:

WIRE MGMT PANEL	WM-B(2RU)		
	Standard of Quality	Additional Approved Prod-uct	Additional Approved Prod-uct
Manufacturer:	HOMACO	MIDDLE ATLANTIC	HUBBELL
H/W Inches:	3.5/19"	3.5/19"	3.5/19"
Panel	HFM-19-2SRC	HCM-2DR	HC219GC36
Vert.Cable Mgmt Rings:	NONE	NONE	NONE
Front Cord Rings:	INCL	INCL	INCL
Rear Cable Channel	INCL	INCL	INCL

      2) 1 Rack Space units:

WIRE MGMT PANEL	WM-B(1RU)		
	Standard of Quality	Additional Approved Prod-uct	Additional Approved Prod-uct
Manufacturer:	HOMACO	MIDDLE ATLANTIC	HUBBELL
H/W Inches:	1.75/19"	1.75/19"	1.75/19"
Panel	HFM-19-1SRC	HCM-1DR	HC119GC36
Vert.Cable Mgmt Rings:	NONE	NONE	NONE
Front Cord Rings:	INCL	INCL	INCL
Rear Cable Channel	INCL	INCL	INCL

C. Non-Voice/Data Rack Cable Management
   1. Horizontal Cable Lacing Bars
   2. Steel construction
   3. Baked on enamel finish
      a. Coordinate exact model(s) supplied with system supplier. Furnish LBR-1A when supplied rack is provided for future use.
   4. Additional Approved Manufacturers: Atlas-Sound, Lowell Manufacturing
   5. Quantity: Furnish (1) lacing bar for each 5-1/4" of vertical rack mounting space for each supplied equipment rack.

D. Vertical Cable Lacing Bars
   1. Steel construction
   2. Baked on enamel finish
   3. 2-inch wide
   4. Perforated design for easy mounting to rails within equipment racks and for securing cable tie wraps.

5. Basis of Design: Middle Atlantic LACE Series.
   a. Coordinate exact models supplied with system supplier. Furnish LACE-P, sized to suit, when supplied rack is designated for future use.
6. Quantity: Furnish minimum (4) lacing bar for each equipment rack supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Ladder Rack
   1. Within Communication Rooms
      a. Within ER, TR, IDF, MDF communication rooms, ladder rack shall be installed to facilitate Cable Management within the space.
      b. Where related drawings indicate specific routing, size and location of ladder rack, install ladder rack as indicated in these drawings.
      c. Where related drawings do not expressly depict ladder rack in communication rooms, supply and install ladder rack as follows:
         1) 12” horizontal ladder rack, minimum size, installed around the entire perimeter of the room. Install rack 12” below finished ceiling, but not less then 86” above finish floor. Install at a height that does not interfere with doors, windows and other equipment within the room.
         2) 12” horizontal ladder rack, minimum size, installed directly above and parallel to floor mounted equipment racks below. Ladder rack shall intersect and join the perimeter ladder rack.
         3) 12” vertical ladder rack, minimum size, installed on the wall at every floor and/or ceiling cable penetrations. Cable tray shall extend from the penetration to the perimeter cable tray.
         4) Furnish larger ladder rack sizes, as required, to accommodate all cables within the room.
         5) See “Horizontally Mounted” and “Vertically Mounted” installation guidelines for additional information.
   2. Horizontally Mounted
      a. Install ladder rack using manufacturer recommended hardware and accessories including, but not limited to: splice extension clamps; horizontal tee splice kits; corner support kits; adjustable vertical bend kits; adjustable vertical splice kits; runway support kits designed for ceiling
      b. support from all threaded rod; runway drop-out at equipment racks; runway end caps; etc.
      c. Install waterfall fittings in every location where cable is intended to exit the ladder rack downward, at the end of a run as well as between the rungs.
      d. Support with threaded rod and U-channel supports systems.
      e. Ladder rack shall be installed approximately 96” A.F.F, near the top of the backboards, unless otherwise noted on the drawings.
      f. Rack mounted with a side along a backboard, may mount with wall brackets; utilize threaded rod and manufacturer’s bracket kits for suspension of all remaining ladder rack sections.
      g. Install as a complete system in accordance with manufacturer’s written installation instructions as indicated on the Drawings and to ensure electrical continuity of the system and adequate support for the cabling. Provide all manufacturer’s recommended fittings and accessories.
      h. Provide support for the ladder rack at a minimum of 4’ 6” on center and at all splices, tees, elbows, bends, intersections, and transitions.
         1) Support with threaded rod and U-channel supports systems
            a) 12” width – ½” ATR; 24” width – 5/8” ATR
         2) Rod lengths over 6’ will require a “Rod Stiffener” installation.
            a) A section of U-Channel stock is placed around the rod and stiffener clamp assemblies used to clamp to rod

b) Place clamps a minimum of 6" from the top and bottom of the rod and every 18" in between.

i. Install the ladder rack system free of all sharp edges, burrs or projections that could harm cables or humans.
j. Provide side posts at 2' on center to both sides of the rack lengths.
k. Provide end caps as specified.
l. Install "waterfall" type protection for cable exit downward between rungs. l. Paint fittings as required to maintain aesthetic integrity of the installation. m. The ladder rack shall be ceiling supported with wall bracing at rack ends.

3. Vertically Mounted
   a. Ladder rack rails shall mount flush against the backboard with rungs out.
   b. Mount flat to backboard with wall mount clamps.
   c. Rack mounted with one end on the floor and extending to intersecting cable tray/ladder rack used for horizontal cable delivery.
   d. Install as a complete system in accordance with manufacturer's written installation instructions as indicated on the Drawings and to ensure electrical continuity of the system and adequate support for the cabling. Provide all manufacturer's recommended fittings and accessories.
   e. Provide support for the ladder rack at a minimum of 3' on center up the entire length.
   f. Install system free of all sharp edges, burrs or projections.
   g. Ground and bond the system in accordance with the NEC and ANSI/TIA/EIA 607.
   h. Provide end caps on all exposed ladder rack ends.
   i. Trim out rectangular slot of appropriate size in ceilings, where applicable, to enable cable passage to above ceiling lines.
   j. Paint fittings to maintain aesthetic integrity of the installation.
4. Spillways, Waterfalls, Cable Drop-outs
   a. Shall mount securely to ladder rack rails and shall maintain minimum bend radius on all cables entering or exiting the ladder rack.
   b. Install cabling exits a conduit sleeve, cable tray, or ladder rack and the cable(s) will be unsupported for more than six inches.

B. Rack Mount Cable Management
   1. All cable management panels shall be securely attached with recommended screws.
   2. Install panels in positions indicated on related drawings.
   3. Perform final coordination with other specification systems prior to installation.

END OF SECTION 27 11 23

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SECTION 27 11 26

COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Supply and installation of uninterruptible power supplies for communications equipment.
   2. Supply and installation of AC power distribution products for communications equipment.

1.2 SYSTEM DESCRIPTION / DESCRIPTION OF WORK

A. Equipment racks, cabinets, frames and enclosures shall be provided with

B. Uninterruptible Power Supplies (UPS) as indicated on the drawings.

C. UPS shall be installed in all other locations as identified in this section and on the drawings.

D. UPS shall supply power to equipment with the associated rack, cabinet, frame or enclosure in the event of any input power loss to the UPS.

E. Power distribution systems shall be provided within all equipment racks, cabinets, frames and enclosures and shall be sufficient to deliver to all equipment contained within them.

F. Power distribution products shall be provided on all communication backboards as indicated on the drawings and as additionally required to distribute power to all products mounted to the communications backboards.

G. 20% minimum, unused spare AC power receptacles shall be provided in all equipment racks, cabinets, frames and enclosures. This spare capacity shall be remain for owner use after all specified and pre-designated future systems are installed.

1.3 SUBMITTALS

A. Product Data
   1. Manufacture datasheets for all system equipment
   2. Complete BOM list
      a. BOM shall include the following information for each product:
         1) Contractor's quantity estimates.
         2) Manufacturer name.
         3) Manufacturer model number (as it appears on manufacturer's product data sheet).
         4) Manufacturer product description.
         5) Paragraph number of this section where the product is specified.

B. Shop Drawings
   1. Power Distribution Block Diagrams(s)
      a. Drawings shall depict the specific power products and the exact AC power distribution configuration for each rack.

b. Separate power distribution diagrams shall be prepared and submitted for each rack, cabinet enclosure shall be presented on a separate drawing.
   1) Where identical power distribution arrangements are being planned to be supplied for multiple racks a typical shall be supplied that clearly identifies every rack (by Device ID) that will be using that specific power distribution plan.

C. Quality Assurance
   1. RCDD Certification for the staff member responsible for this project.
   2. Resume of the last 10 projects of the RCDD responsible for this project
   3. BICSI Technician's certificate for each lead Technician(s) on the project

D. Closeout Submittal
   1. Power Distribution Block Diagram(s)
      a. Drawings shall depict the specific power products and the exact AC power distribution configuration for each rack

1.4 DELIVERY, STORAGE AND HANDLING

A. Products of this section shall be furnished in timely manner to coordinate with work of other sections.

PART 2 - PRODUCTS

2.1 GENERAL

A. All AC power products furnished shall be UL Listed for the location and manner in which the product will be installed and used.

B. All products furnished of a given type under this section shall be manufactured by a single manufacturer; shall bear the same brand name; shall be of the same finish color and texture; and shall be from the same product model series unless otherwise noted and/or approved by the Designer.

2.2 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

A. General
   1. Unless otherwise noted on the drawings, all UPS units shall be manufacturer designed for rack mounting and shall be furnished with all mounting hardware.

B. 2kVA Size
   1. True on-line double conversion.
   2. Furnished with power management software.
   3. 120VAC input and output.
   4. 19" EIA rack mounting hardware
   5. NEMA 5-20 plug
   6. Four (4) NEMA 5-20 receptacles
   7. Basis of Design: Liebert GXT3 Series
   8. Additional approved manufacturer(s): APC

C. 3kVA Size
   1. True on-line double conversion.
   2. Furnish with power management software.
   3. 208VAC input and output.
   4. 19" EIA rack mounting hardware
   5. NEMA L6-30 plug
   6. 4 NEMA 5-15R Receptacles

7. One NEMA L5-30R Receptacle
8. Basis of Design: Liebert GXT3 Series
9. Additional approved manufacturer(s): APC

2.3 POWER DISTRIBUTION

A. General
1. Furnish receptacles of the amperage rating matching the power feed(s) to the rack.

B. Within Voice/Data Equipment Racks
1. 15A Vertical multi-outlet power strips (Use with 3KVA RM UPS)
   a. 120VAC input
   b. NEMA 5-15R receptacles (14 – 24 outlets)
   c. 45 - 72 inch length
   d. 9 foot power cord with Nema5-15P plug
   e. Basis of Design: Middle Atlantic PD-1415C-NS and PB-5A brackets.
   f. Additional approved manufacturers:
      1) Great Lakes Case & Cabinet #7215
      2) Hoffman # AP722415
2. 20A Vertical multi-outlet power strips (Use with 2KVA RM UPS or Floor Model and Power Distribution Panel within room.)
   a. 120VAC input
   b. NEMA 5-20R receptacles (14 - 24 outlets)
   c. 49 - 72 inch length
   d. 9 foot power cord with NEMA 5-20P plug
   e. Basis of Design: Middle Atlantic PD-1220C-NS and PB-5A brackets.
   f. Additional approved manufacturers:
      1) Great Lakes Case & Cabinet #7215-20AR
      2) Hoffman # AP722420

C. Within Sound Reinforcement and Audio-Video Systems equipment racks
1. General
   a. Each rack shall be furnished with a complete and working AC power distribution system.
   b. System shall consist of a remotely controllable power sequencer and AC power outlets controlled by this sequencer.
   c. Refer to both Communication Technology and Electrical series drawings to determine the presence of isolated-ground circuits feeding the equipment rack(s). Provide isolated ground versions of power distribution products as required to match power supplied.
   d. Where rack is designated for future use and where no system is specified for the rack, furnish (2) discrete vertical receptacle strips, each strip containing at least one (1) AC receptacle for every 5-1/4” inches of rack mounting space within the equipment rack.
2. Integrated Power Sequencing System
   a. Equipment racks with fewer then 12 products requiring AC power, and less then 12 amperes of continuous current draw shall be provided with an integrated power sequencing system plus supplemental power strips. This system shall consist of.
      1) Rack mounted power sequencer with integral AC receptacles
      2) Supplemental Vertical AC power strips.
   b. Rack Mounted Power Sequencer
      1) Rack Mounted
      2) Front panel power switch
      3) Low-voltage remote control input
      4) Low-voltage status output port
      5) 120VAC Input
      6) (6) Nema5-15R Duplex Receptacles
      7) Nema5-15P Input plug
      8) 15 amp current rating
      9) Basis of Design: Middle Atlantic PDS-615R
   c. Vertical Power Strips

1) Furnish quantity of individual strips containing the quantity of receptacles required (plus 20% spares) to fit within the supplied equipment rack(s).
2) Basis of Design: Middle-Atlantic PD-Series

3. Modular Power Sequencing System
   a. Equipment racks with greater then 12 products requiring AC power or a continuous current draw of 12 amperes or more shall be furnished with a complete and working modular power sequencing system consisting of:
      1) Power Sequence controller
      2) 6-circuit capable, 6-duplex outlet modular power distribution strips.
      3) Supplemental vertical power strips adequate AC receptacles to accommodate all equipment in the equipment rack (plus 20% spare capacity).
   b. Power Sequence Controller
      1) Six (6) low voltage control outputs
      2) External remote control inputs
      3) Status output ports
      4) 19" EIA rack mountable
      5) 1 Rack unit high
      6) Front panel power switch and status LEDs
      7) Basis of Design: Middle-Atlantic USC-6R Universal Sequence
      8) Controller
      9) Additional approved manufacturers: Brand/Model specific pre- approval required.
   c. Modular Vertical Raceway System
      1) Raceway
         a) 3-Module Modular Raceway
            (A) Overall Length: 32 inches
            (B) Basis of Design: Middle-Atlantic MPR-3
         b) 6-Module Modular Raceway
            (A) Overall Length: 56 inches
            (B) Basis of Design: Middle-Atlantic MPR-6
         c) 9-Module Modular Raceway
            (A) Overall Length: 80 inches
            (B) Basis of Design: Middle-Atlantic MPR-9
      2) Power Modules
         a) 20Amp – 120volt – Remote Controllable
            (A) Nema5-20R Duplex Receptacle
            (B) Basis of Design: Middle-Atlantic RM-20
         b) 20Amp – 120volt – Remote Controllable – Isolated Ground
            (A) Nema5-20R(IG) Duplex Receptacle
            (B) Basis of Design: Middle-Atlantic RM-20IG
         c) 15Amp – 120volt – Remote Controllable
            (A) Nema5-15R Duplex Receptacle
            (B) Basis of Design: Middle-Atlantic RM-15
         d) 15Amp – 120volt – Remote Controllable – Isolated Ground
            (A) Nema5-15R(IG) Duplex Receptacle
            (B) Basis of Design: Middle-Atlantic RM-15IG
         e) Blank Modules
            (A) Basis of Design: Middle-Atlantic MPR-BL
      3) Jumper Cables
         a) Receptacle to receptacle power jumpers
         b) 12, 24 and 72 inch length available
         c) Connectorized at both ends to mate with receptacles
         d) Basis of Design: Middle-Atlantic J series
         e) Tail Cables
         f) Basis of Design: Middle-Atlantic T series
4. Vertical Power Strips
   a. Basis of Design: Middle-Atlantic PD-Series
   b. Furnish quantity of individual strips containing the quantity of receptacles required (plus spares) to fit within the supplied equipment rack(s).

D. Within Public Address, Intercom, and Security System(s) Equipment Racks

1. General
   a. Each rack shall be furnished with a complete and working internal power distribution system consisting of enough AC receptacles to accommodate all equipment to be housed within the equipment rack, plus a 20 percent spare outlet capacity.
   b. Refer to both Communication Technology and Electrical drawings to determine the presence of isolated-ground circuits feeding the equipment rack(s). Furnish isolated ground versions of power distribution products to match incoming power feed(s).
   c. Where rack is designated for future use and where no system is specified for the rack, furnish (2) discrete vertical receptacle strips, each strip containing at least one (1) AC receptacle for every 5-1/4" inches of rack mounting space within the associated equipment rack.
2. Vertical Rack Power Strips
   a. Full Rack Length
   b. 120VAC operating voltage
   c. 20-Amp and 15-Amp capacity versions
   d. Standard and Isolated Ground versions
   e. Basis of Design: Middle Atlantic PD Series
   f. Additional Approved Manufacturers: Wiremold, Hammond
   g. Manufacturing, Tripplite
3. Rack Mount Receptacle Strips
   a. 20 Amp – Non-Isolated Ground Version
      1) 19" EIA Rack Mountable
      2) 1-3/4" High
      3) 20Amp Nema5-20P Plug
      4) 6' AC Power Cord
      5) Integral 20Amp Circuit Breaker
      6) Front Panel AC power switch
      7) No front panel receptacles
      8) Minimum of 6 rear-mounted Nema5-20R receptacles
      9) Basis of Design: Hammond Manufacturing 1589H6F1BKRR
   b. 15Amp – Non-Isolated Ground Version
      1) 19" EIA Rack Mountable
      2) 1-3/4" High
      3) 15Amp Nema5-15P Plug
      4) Receptacles rotated 90 degrees (i.e. perpendicular) to length receptacle strip
      5) 6' AC Power Cord
      6) Integral 15Amp Circuit Breaker
      7) Front Panel AC power switch
      8) No front panel receptacles
      9) Minimum of 6 rear-mounted Nema5-15R receptacles
      10) Basis of Design: Hammond Manufacturing 1583H6A1BKRA

E. Within all Other Equipment Racks
1. Unless otherwise specified herein and/or shown and/or noted on the related drawings each supplied rack shall be provided, minimally, with the following:
   a. One (2) 15-Amp 120VAC Single-circuit vertical power receptacle strips.
   b. Receptacle strip shall contain at least (1) Nema5-15R AC power outlet for each 3-1/2" of vertical rack mounting space. For example: A 44-rack unit cabinet shall have at least 22 total AC outlets.
   c. One (1) 20Amp 120VAC Single-circuit horizontal AC rack-mount AC power receptacle strip. Receptacle strip shall contain (6) Nema5-20R AC power outlets.

PART 3 - EXECUTION

3.1 COORDINATION

A. This Contractor shall coordinate with all other Contractors and sub-contractor(s) supplying and installing equipment racks, cabinets, frames and enclosures as well as the contractors providing

3.2 INSTALLATION

A. General
   1. Secure all fixed position equipment racks using removable threaded fasteners to prevent equipment racks from movement and tipping over.

B. Uninterruptible Power Supplies and Power Distribution
   1. General
      a. Coordinate directly with each system/equipment supplier/contractor/sub- contractor prior to installation of UPS, sequential controllers and receptacle strips to coordinate the installed location of these products. Location of these products shall complement the location of all connected products.
   2. Uninterruptible Power Supplies (UPS)
      a. Plug UPS into un-switched AC power source.
      b. Rack-mount both the power supply(s) and their accessory batteries as applicable.
   3. Telecommunication Racks
      a. Mount receptacle strips vertically in the rear of a cabinet or on rear of open frame relay racks.
      b. When UPS products are present, connect receptacle strips into outlets located on the UPS.

3.3 POWER DISTRIBUTION DEVICES:

A. Provide specified plug-in outlet centers in each equipment rack or backboard.
   1. Plug-in outlet centers shall be securely mounted to the equipment rack utilizing
   2. Manufacturer's recommended hardware.
   3. Position to allow the Owner adequate access and avoid functionality conflicts with rack features (i.e. adjustable rails).

END OF SECTION 27 11 26

SECTION 27 13 23

COMMUNICATIONS FIBER OPTIC BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Supply and installation of a complete and working Fiber Optic Backbone Cabling Systems for
   1. Multi-Purpose Fiber Optic Backbone
      a. Including Data connectivity provisions for Data Network and Other Systems (i.e. Video Surveillance, Access Control, Control Data, Intrusion Detection, etc.).
   2. System includes but is not limited to:
      a. Backbone cabling.
      b. Connectors
      c. Patch panels

1.2 REFERENCES

A. ANSI/TIA/EIA-568-B – Commercial Building Telecommunications Cabling Standard.

B. ANSI/TIA/EIA-569-A – Commercial Building Standard for Telecommunications Pathways and Spaces.

C. ANSI/TIA/EIA-606 – The Administrative Standard for the Telecommunications Infrastructure of Commercial Building.

D. ANSI/TIA/EIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.

E. ANSI/TIA/EIA 568 B.1 (SP-4425) General Cabling Systems Requirements

F. ANSI/TIA/EIA 568 B.3 (PN-3894) Optical Fiber Cabling Systems.

G. "TELECOMMUNICATIONS DISTRIBUTION METHODS MANUAL" published by the Building Industry Consulting Services International (BICSI).

1.3 SYSTEM DESCRIPTION / DESCRIPTION OF WORK

A. The system shall be a multi-strand Fiber Optic backbone cabling system
   1. Provide, test, and label all cables and terminations devices as described below and as shown on the plans.
   2. The system shall be an ANSI/TIA/EIA 568-B compliant Fiber Optic backbone cabling system.
   3. See related Drawings for specific Project requirements.
   4. The system shall consist of total connectivity for a complete and permanent installed communications link.
   5. Refer to Backbone Diagram for types, quantities of cables.
   6. Refer to detail drawings for terminations standards and positioning of termination devices.
   7. Refer to floor plans for termination locations.
   8. All cables shall be continuous without splices and shall be of proper construction for the designated use.
   9. All system cables shall be UL/NEC rated for the location, manner and site conditions in which the cables are installed. This includes, but is not limited to:
      a. Use of the cable rated for the application

b. Not exceeding fill capacities of raceways
c. All cable used shall be in compliance with Local, State, and Federal laws (at minimum the NFPA published "National Electric Code") as to acceptability for placement in the designed pathway. This includes, but is not limited to, cable fill capacities of raceways and plenum vs. non-plenum construction. The Contractor shall provide and install the appropriate cable for the appropriate conditions.
d. Fiber Optic Backbone (Multi-purpose)

1.4 QUALITY ASSURANCE

A. The Prime Contractor or his subcontractor responsible for this Section shall have a Registered Communications Distribution Designer (RCDD) on staff that will be ultimately responsible for this Project. The RCDD must have sufficient experience in this type project as to be able to lend adequate technical support to the field forces during installation, the warranty period, and any extended warranty periods or maintenance contracts. If in the opinion of the Owner, the RCDD does not possess adequate qualifications to support the Project, the Owner reserves the right to require the Contractor to assign an RCDD who, in the Owner's opinion, possesses the necessary skills and experience required of this Project.

B. The lead technician(s) on the Project shall carry a current BICSI Technician Certificate or have five years of experience in projects of similar scope.

C. The lead technician(s) on the Project shall have a thorough understanding of the following:
1. American National Standards Institute/Telecommunications Industry Association/Electronics Industry Association – ANSI/TIA/EIA 568B Commercial Building Telecommunications Cabling Standard.
2. American National Standards Institute/Telecommunications Industry Association/Electronics Industry Association – ANSI/TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and spaces.
3. American National Standards Institute/Telecommunications Industry Association – ANSI/TIA/EIA 606 The Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings.
4. American National Standards Institute/Telecommunications Industry Association/Electronics Industry Association – ANSI/TIA/EIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications.

D. All Work shall fully comply with these specifications and related Drawings and all manufacturers recommended installation practices.

1.5 SUBMITTALS

A. General
1. Product Data and Shop Drawing submittals for work of this section shall be SUBMITTED TOGETHER, complete, as a single submittal. Product Data and Shop Drawings are not to be submitted separately.
2. Samples shall be submitted with or immediately following submission of Product Data submittals.

B. Product Data
1. Manufacture datasheets for all system equipment
2. Manufacture datasheets for all cable
3. Manufacture datasheets for all connectors
4. Complete BOM list
   a. BOM shall include the following information for each product:
      1) Contractor's quantity estimates
      2) Manufacturer name
      3) Manufacturer model number (as it appears on manufacturer's product data sheet)

4) Manufacturer product description
5) Paragraph in this section where product is specified.

C. Shop Drawings
1. Plan Drawing(s)
a. Depicting the location of all drops and major equipment locations at the project site, coordinate with work of related sections.
2. System Riser Diagram(s).
a. Depicting the interconnecting cabling between system equipment located at different locations at the project site.
3. System block wiring diagram, detailed.

D. Quality Assurance / Control Submittals
1. RCDD Certification for the staff member responsible for this project.
2. Resume of the last 10 projects of the RCDD responsible for this project
3. BICSI Technician's certificate for each lead Technician(s) on the project

E. Closeout Submittal
1. Backbone diagram indicating all backbone cables and the connectivity provided;i.e. show cable types and the to-and-from locations for each.
2. Equipment Room/Telecommunications Room rack/cabinet layouts (to scale) showing rack space used by each installed component.
3. A diagram of the labeling scheme used on the Project.
4. Cable manufacturer's certification of quality and performance.
5. Extended Warranty Certificate.

1.6 WARRANTY

A. Additional requirements: All cabling and connectivity products manufacturers, including patch cords, shall have in place an agreement recognizing each other for complete execution of warranty as specified. All performance and applications warranties shall be channel rated.
1. The cable manufacturer and the connectivity products manufacturer shall have a partnership agreement established in order to provide the required warranty.
2. Required warranty:

PART 2 - PRODUCTS

2.1 PRODUCT STANDARDS

A. General
1. This section is designed to provide the Contractor with a minimum Basis of Design and functionality for the products used for telecommunications infrastructure.
2. This standard will be considered in force for the original response as well as for any additions or changes to this Project. Due to this, there may be items listed in the Products section that are not required under the scope of this contract.
3. Products required by the Drawings but not enumerated will be evaluated as a performance specification based on the information provided on the Drawings.

2.2 CABLES

A. General
1. All cables on this Project shall be color-coded. Refer to Division 27 Section "Identification for Communications".
2. OFNP and OFNR references below are as required by the NEC published by the

3. National Fire Protection Association.
   a. Cables not specifically identified otherwise, shall be provided with CMP classification.
   b. Exceptions:
      1) Requirements for Outside Plant Rated cables.
      2) Cables run in continuous conduit.
      3) Proper cable classification is ultimately determined by building construction; reductions in classification for cables, not clarified or altered by addendum to the specifications, will require a deduct in price through a change order.
4. All references below for pathways, conduits, etc. are as defined by Division 27 Section “Pathways for Communications”.

B. Fiber Optic Cables:
1. General
   a. Where Multimode and Singlemode fiber optic cable requirements share the same start point, the same end point, and the same pathway, hybrid cables may be used to combine the Multimode and Singlemode strands under a common jacket.
   b. All indoor fiber optic cable shall be of interlocking armored construction.
      1) Any fiber optic cable not of interlocking armored construction shall be installed in a properly rated (plenum) inner-duct as specified in related Division 27 Section “Pathways for Communications”.
2. Optical Requirements:
   a. All Multimode fiber optic cable is required to have the following optical characteristics:
      1) Optimized multi-mode fiber cable shall be 50/125 micron diameter with dual window of 850/1300 nm with industry standard color coding.
      2) Cable shall meet or exceed ISO/IEC 11801 OM4 Grade 6 optical characteristics.
      3) Optical characteristics shall include minimum Modal Bandwidth of
      4) 4700 MHz/km (EMB) at 850nm and 500 MHz/km at 1300nm allowing guaranteed GigaBit Ethernet distances of 1000 m at 850 nm and 550 m at 1300 nm with guaranteed 10 Gigabit Ethernet distances of 550 m at 850nm and 300 m at 1300 nm.
      5) Maximum attenuation – (dB/km) 3.5 at 850 nm and 1.5 at 1300 nm.
   b. All Singlemode fiber optic cable is required to have the following optical characteristics:
      1) Singlemode fiber cable shall be 8.3/125 micron diameter with dual window of 1310/1550 nm with industry standard color coding. Cable shall meet TIA/EIA 492-CAAA.
         a) Maximum attenuation – (dB/km) .7 @ 1310 nm and .7 @ 1550 nm.
3. Construction
   a. Cable shall be of all-dielectric construction unless specifically noted otherwise.
   b. All fiber optic cable will be properly constructed for the environmental conditions and to meet all applicable codes.
   c. The following basic construction types are recognized on this Project:
      1) Tight buffer armored premise distribution cable
      2) Plenum (OFNP) rated construction unless otherwise specifically noted.
      3) Used in indoor pathways primarily as backbone cable.
      4) Fiber counts can range from 4 to 72 strands
      5) Hybrid SM/MM strand mix is acceptable.
      6) This cable construction will never be used in an outdoor or harsh environment.
      7) Multimode Basis of Design shall be as manufactured by
      8) General Cable BL024IPNU-ILP(A) (MM 24 STRAND)
      9) Singlemode Basis of Design shall be as manufactured by General Cable AP006IPNU-ILPA (SM 6 STRAND) (Confirm Color and Strand Count)
      10) Additional approved manufacturers: Berk-Tek, Mohawk, Corning.

2.3 TERMINATION HARDWARE

A. General
1. Suggested layout of termination hardware is indicated on the Drawings. Coordinate layout of termination hardware with the Owner’s Representative or Consultant/Architect/Engineer before installation.

2. The manufacturer of the cable and the manufacturer of the connectivity products shall have a partnership agreement established in order to provide the required warranty. See Warranty requirements above and in related Section 27 00 01.00.
3. All devices shall be UL listed as required by the NEC published by the National Fire Protection Association.

B. Equipment/Telecommunications Room Cabinet/Rack
1. The following basic termination devices are available and recognized for this Project.
   a. Fiber Optic Patch Panel 24 port
      1) Panel shall be black steel with smoked Plexiglas door
      2) Rear tray capacity for optional splice trays
      3) Slack management spools included
      4) Drawers slide out for easy front access
      5) Accepts standard 6-pack assemblies; 4 units (FAP or FMP)
      6) Mountable in 1 rack space (1.75") EIA standard 19" rack/cabinet rails.
      7) Must use F/O Coupler Packs; see below
      8) Basis of Design shall be Panduit FMD1
         a) Additional approved manufacturers: Hubbell, Leviton, Ortronics
   b. Fiber Optic Patch Panel 48 port
      1) Panel shall be black steel with smoked Plexiglas door
      2) Rear tray capacity for optional splice trays
      3) Slack management spools included
      4) Drawers slide out for easy front access
      5) Accepts standard 6-pack assemblies; 8 units (FAP or FMP)
      6) Mountable in 2 rack spaces (3.50") EIA standard 19" rack/cabinet rails.
      7) Must use F/O Coupler Packs; see below
      8) Basis of Design shall be Panduit FMD2
         a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics
   c. Fiber Optic Coupler Packs - Multimode
      1) Panel shall be black steel individual couplers installed
      2) Mounts in 24 or 48 port Fiber Optic patch panel
      3) 6 duplex LC adapters with phosphor bronze sleeves (MM)
      4) Color code MM couplers Aqua
      5) Basis of Design shall be Panduit FAP6WAQDSC
         a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics
   d. Fiber Optic Coupler Packs - Singlemode
      1) Panel shall be black steel individual couplers installed
      2) Mounts in 24 or 48 port Fiber Optic patch panel
      3) 6 simplex LC adapters with ceramic sleeves (SM)
      4) Color code SM couplers Blue; utilize industry standard color coding
      5) Basis of Design shall be Panduit FAP6WBUSCZ
         a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

C. Wall-mounted Termination
1. The following basic termination devices are available and recognized for this Project.
   a. Wall Mounted Fiber Optic Patch Panel 24 port
      1) Panel shall be black steel with dual doors and locks
      2) Tray capacity for optional splice trays
      3) Slack management spools included
      4) Accepts standard 6-pack assemblies; 4 units (FAP or FMP)
      5) Wall Mountable; 13" x 16" x 5"
      6) Must use F/O Coupler Packs; see below
      7) Basis of Design shall be Panduit FWME4
         a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics
   b. Fiber Optic Coupler Packs - Multimode
      1) Panel shall be black steel individual couplers installed
      2) Mounts in 24 or 48 port Fiber Optic patch panel
      3) 6 duplex LC adapters with phosphor bronze sleeves (MM)
      4) Provide adapter plate with couplers to match specified fiber performance. Utilize industry standard color coding.

5) Basis of Design shall be Panduit
a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

c. Fiber Optic Coupler Packs - Singlemode
1) Panel shall be black steel individual couplers installed
2) Mounts in 24 or 48 port Fiber Optic patch panel
3) 6 simplex LC adapters with ceramic sleeves (SM)
4) Provide adapter plate with couplers to match specified fiber performance.
a) Color code SM couplers Blue; utilize industry standard color coding
5) Basis of Design shall be Panduit
a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

D. Discrete Cable Connectors
1. The following basic termination devices are available and recognized on this Project:
a. LC Connector Multi-mode
1) Provide connector to match specified fiber performance; utilize industry standard color coding.
2) Each connector shall use a U/V or adhesive/epoxy to firmly adhere the glass strand to the connector.
3) The connector ferrule shall be ceramic.
4) The connector must provide 0.10dB typical attenuation or less
5) Provide duplex LC clip, as required
Standard of quality shall be Panduit. Additional approved manufacturers: 3M, Leviton, Ortronics, or Hubbell.
b. LC Connector Single-mode
1) Provide connector to match specified fiber performance; utilize industry standard color coding.
2) Each connector will use a U/V or adhesive/epoxy to firmly adhere the glass strand to the connector.
3) The connector ferrule shall be ceramic.
4) The connector must provide 0.15dB typical attenuation or less
5) Provide duplex LC clip, as required
6) Standard of quality shall be Panduit. Additional approved manufacturers: 3M, Leviton, Ortronics, or Hubbell
c. Fiber Optic Break-out (fan-out)/(furcation) kit.
1) Shall be used for all fiber optic cable terminations
2) Shall include buffer tubing and heat shrink tubing for each strand to have an 18” length from break-out.
3) Basis of Design shall be Corning cable Systems FAN-BT25-xx
4) (Indoor) or FAN-OD25-xx (Outdoor)
a) Additional approved manufacturer(s): Hubbell, Leviton, Ortronics Panduit

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. This section is designed to provide a Basis of Design and functionality for the installation of technology systems infrastructure. Not all procedures will be necessary for the installation of this Project; however, this standard shall be considered in force for the original response as well as for any additions or changes to this Project.

3.2 INSTALLATION

A. Coordination
1. Review and coordinate proper pathways prior to installation.

2. Reference the TELECOMMUNICATIONS DISTRIBUTION METHODS MANUAL (TDMM) published by the Building Industry Consulting Services International (BICSI) for cable installation practices. This Specification may take exception to optional statements within the TDMM. Treat any conflict per this Specification under discrepancies or Conflicts.

B. General
1. Cable routing shall follow building structure lines and shall be installed with adequate length to reach to any location within the equipment racks with at least 5 feet of service loop at each end.
2. At point of final terminations, excess cable and the service loop shall be stored and dressed neatly.
   a. At the station end of the cable the service loop shall be stored above the ceiling line at an accessible point and supported with an approved device designed for that purpose.
   b. Within a communications room the service loop shall be dressed and stored within the ladder rack.
3. Provide strain relief at all connection points. Strain relief techniques shall be applied to all cables to lessen the risk of physical cable damage and to provide proper aesthetic value.
4. Route all cabling and pathways parallel to building surfaces and at 90 degree angles to the building structure.
5. Cable runs shall be continuous and without splices.
6. Wiring shall be free from grounds, shorts, opens, and reversals.

C. Protection:
1. Maintain protection of all cabling throughout the entire duration of the project.
2. Cabling shall not be left hanging or coiled where it potentially obstructs the Work of other contractors or trades. Cabling shall be bundled, supported, and protected up out of the way of other trades any time it is determined necessary to ensure the safety of personnel or protection of the cable.
3. Do not terminate cables designated for different services onto the same patch panel unless otherwise clearly indicated on the drawings.
4. Do not exceed minimum bend radius or pulling tension specifications set forth by the product manufacturer.
5. Cable Separation and Organization
   a. Cables of different services shall not be intertwined.
   b. Cables of all service types shall be organized and kept segregated within cable trays, ladder rack, wire management and other pathways.
   c. Terminate all cabling on specified termination hardware in numerical order and on specified outlets.

D. Labeling
1. Every cable shall have a label applied to the jacket at each end.
2. Each terminating device and port shall have a unique identifier.
3. Label all cabling and terminations as specified and indicated on related drawings.

E. Raceways
1. Install cabling within conduit or in surface raceway where specified in this or related sections or as indicated on the drawings.
   a. Surface raceway is permissible for use only where expressly indicated on the drawings.
2. Cabling shall be installed in a concealed manner. Cables may be visible only in the following areas. (Provide concealed rough-ins for all device and outlet locations.)
   a. Equipment Rooms
   b. Telecommunications Rooms
   c. Building spaces equipped with cable trays but without finished ceilings to conceal the cables.
3. Install cabling in cable tray and ladder rack where specified in this or related sections or as indicated on the drawings.
4. Support cables using approved products and methods whenever conduit, surface raceway or cable tray are not specified. Cable supports shall be attached directly to building structure.
5. Entry/exit from raceways shall be made in a uniform and consistent manner and shall not exceed the minimum bend radius of the cable.
6. Route all cabling and pathways parallel or at 90 degree angles to the structure.

7. Support cabling with the appropriate cable supports and from the building structure.

F. Wall and Floor Penetrations
1. Provide conduit sleeves with bushings on each end for all cabling penetrations. Split bushings shall not be permitted. Patch and firestop around the sleeve. Firestop the interior of the sleeve after cable is installed.
2. Firestop all firewall penetrations to return the wall to its original rating. Outlet boxes installed in firewalls shall be similarly firestopped.

G. Cable Supports
1. Neatly dress, support and securely attach all cabling on backboards and in equipment racks.
2. Where cabling is not supported by cable tray or conduit, provide necessary cable support as specified. Provide nylon cable tie at the support to contain cabling within the support. Do not bundle cable between supports. Provide cable support as specified at intervals not to exceed 5 feet. Do not secure cabling to the support. Do not use cable supports with round surfaces (i.e. bridal rings).
3. Route all cabling and pathways parallel or at 90 degree angles to the structure. Support cabling with the appropriate cable supports and from the building structure.

H. Termination
1. Terminate each end of every cable per the manufacturer's printed instructions.
2. Terminate each cable in numerical order on adjacent ports on the specified termination hardware within the appropriate communications room.
3. Terminate cables using the tools and connectors specified and as recommended by the cable/connector manufacturers' printed instructions.

I. Separation from Sources of Interference
1. Route cables at least 1.2m (4 foot) from motors or transformers; 30 cm (1 foot) from conduit and cables used for AC power distribution; 12 cm (5 inches) from fluorescent lighting fixtures.

J. Backbone cabling:
1. Multimode and singlemode fiber optic cabling shall be terminated with fusion- spliced, factory polished pigtails.
2. Provide service loop as specified or a minimum of 5 feet at each end and 10 feet at each junction point.
3. Do not violate the minimum bend radius specified by the manufacturer of the cable.
4. Provide buffer tubing on all fiber strands from the connector to the cable break- out (minimum 6 inch pigtails) and secure to the cable jacket for all fiber optic cables that do not have a cladding.
5. Route intra-building backbone cabling through primary pathways between
6. Equipment Rooms/Telecommunications Rooms.

3.3 TESTING

A. All cables shall be fully tested and verified compliant with these specifications. All fiber optic cables shall be tested with both a power meter and an OTDR with results stored and submitted in both hard copy and electronic format for review.
1. See Division 27 - Verification Testing of Structured Cabling for additional fiber optic backbone performance testing parameters and procedures.

B. The Owner reserves the right to have a representative present during any or all testing procedures. Verification testing of copper and fiber may be performed at or near Project completion by the Consultant for quality assurance.

C. Upon verification testing, if the Consultant finds the test results do not match the Contractor's results, the Consultant or a third party may at the Owner's request retest all of the cabling and submit those results to the Owner and deduct the verification testing costs from the Contractor's Contract amount.

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SECTION 27 15 13

COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Supply and installation of a complete and working Horizontal Cabling Systems for
      a. Voice / Telephone
      b. Data / Network
         1) Including Data provisions for Other Systems (i.e. Video Surveillance, Access Control, Control Data, Intrusion Detection, etc.).
   2. System includes but is not limited to:
      a. Horizontal cabling.
      b. Station outlets including frames, connector modules, and cover plates.
      c. Patch panels

1.2 REFERENCES

A. ANSI/TIA/EIA-568-B.1 – Commercial Building Telecommunications Cabling Standard.

B. ANSI/TIA/EIA-569-A – Commercial Building Standard for Telecommunications Pathways and Spaces.

C. ANSI/TIA/EIA-606 – The Administrative Standard for the Telecommunications Infrastructure of Commercial Building.

D. ANSI/TIA/EIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.

E. ANSI/TIA/EIA 568 B.1 (SP-4425) General Cabling Systems Requirements

F. ANSI/TIA/EIA 568-B.2 (PN-4426) 100 Ohm Twisted Pair Copper Cabling Systems

G. “TELECOMMUNICATIONS DISTRIBUTION METHODS MANUAL” published by the Building Industry Consulting Services International (BICSI).

1.3 SYSTEM DESCRIPTION / DESCRIPTION OF WORK

A. The system shall be a 4 pair UTP copper Horizontal cabling system.
   1. Provide, test, and label all cables and terminations devices as described below and as shown on the plans.
   2. The system shall be an ANSI/TIA/EIA 568-B compliant Unshielded Twisted Pair (UTP) horizontal cabling system.
   3. The Horizontal voice cabling systems shall be Category 6 compliant system.
   4. The Horizontal data cabling system shall be Category 6 compliant system.
   5. See related Drawings for specific Project requirements.
   6. The system shall consist of total connectivity for a complete and permanent installed communications link.
   7. Refer to detail drawings for terminations standards and positioning of termination devices Provide, test, and label all cables and terminations devices as described below and as shown on the plans.

8. The cable distance between the termination point with a Communications Room(s) and the station outlet(s) shall be no greater then 90 meters (300 ft).
9. The total channel distance shall not exceed 100 meters (328 feet) distance between equipment in the Communications room and station equipment, including all patch cables and station attachment cables
10. All system cables shall be continuous between points of termination, without splices.
11. All system cables shall be UL/NEC rated for the location, manner and site conditions in which the cables are installed. This includes, but is not limited to:
    a. Use of the cable rated for the application
    b. Not exceeding fill capacities of raceways
    c. All cable used shall be in compliance with Local, State, and Federal laws (at minimum the NFPA published "National Electric Code") as to acceptability for placement in the designed pathway. This includes, but is not limited to, cable fill capacities of raceways and plenum vs. non-plenum construction. The Contractor shall provide and install the appropriate cable for the appropriate conditions.

1.4 QUALITY ASSURANCE

A. The Prime Contractor or his subcontractor responsible for this Section shall have a Registered Communications Distribution Designer (RCDD) on staff that will be ultimately responsible for this Project. The RCDD must have sufficient experience in this type project as to be able to lend adequate technical support to the field forces during installation, the warranty period, and any extended warranty periods or maintenance contracts. If in the opinion of the Owner, the RCDD does not possess adequate qualifications to support the Project, the Owner reserves the right to require the Contractor to assign an RCDD who, in the Owner's opinion, possesses the necessary skills and experience required of this Project.

B. The lead technician(s) on the Project shall carry a current BICSI Technician Certificate or have five years of experience in projects of similar scope.

C. The lead technician(s) on the Project shall have a thorough understanding of the following:
1. American National Standards Institute/Telecommunications Industry Association/Electronics Industry Association – ANSI/TIA/EIA 568B Commercial Building Telecommunications Cabling Standard.
2. American National Standards Institute/Telecommunications Industry Association/Electronics Industry Association – ANSI/TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and spaces.
3. American National Standards Institute/Telecommunications Industry Association – ANSI/TIA/EIA 606 The Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings.
4. American National Standards Institute/Telecommunications Industry Association/Electronics Industry Association – ANSI/TIA/EIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications.

D. All Work shall fully comply with these specifications and related Drawings and all manufacturers recommended installation practices.

1.5 SUBMITTALS

A. General
1. Product Data and Shop Drawing submittals for work of this section shall be SUBMITTED TOGETHER, complete, as a single submittal. Product Data and Shop Drawings are not to be submitted separately.
2. Samples shall be submitted with or immediately following submission of Product Data submittals.

B. Product Data
1. Manufacture datasheets for all system equipment

2. Manufacture datasheets for all cable
3. Manufacture datasheets for all connectors
4. Complete BOM list
    a. BOM shall include the following information for each product:
        1) Contractor's quantity estimates
            a) Submission/acceptance of this estimate does in no way relieve the Contractor of the responsibility to provide the materials as required to fulfill all work as specified and as shown on the Drawings.
            b) Manufacturer name
            c) Manufacturer model number (as it appears on manufacturer's product data sheet)
            d) Manufacturer product description
            e) Paragraph number of this section where the product is specified.

C. Shop Drawings
1. Plan Drawing(s)
    a. Depicting the location of all drops and major equipment locations at the project site, coordinate with work of related sections.
2. Equipment Rack Elevations
    a. Scaled
    b. Depicting the locations of all system products installed within the rack, coordinated with work of other sections, as applicable.
3. System block wiring diagram, detailed.

D. Quality Assurance / Control Submittals
1. RCDD Certification for the staff member responsible for this project.
2. Resume of the last 10 projects of the RCDD responsible for this project
3. BICSI Technician's certificate for each lead Technician(s) on the project

E. Closeout Submittal
1. Communication Room Rack Layouts, drawing to scaled, depicting devices and rack space occupied by each installed component.
2. A diagram of the labeling scheme used on the Project.
3. Additional closeout documentation as required in Division 1 and Division 27 "General Requirements for Communications".
4. Cable manufacturer's certification of quality and performance.

1.6 WARRANTY

A. Additional requirements: All cabling and connectivity products manufacturers, including patch cords, shall have in place an agreement recognizing each other for complete execution of warranty as specified. All performance and applications warranties shall be channel rated.
1. The cable manufacturer and the connectivity products manufacturer shall have a partnership agreement established in order to provide the required warranty.
2. Required warranty:
    a. The ANSI/TIA/EIA 568-B Proposed Category 6 compliant cable system shall include as a minimum a 15 year extended product warranty and performance/applications assurance program up to 250 MHz systems.

PART 2 - RODUCTS

2.1 GENERAL

A. This section is designed to provide the Contractor with a minimum Basis of Design and functionality for the products used for telecommunications infrastructure.

B. This standard will be considered in force for the original response as well as for any additions or changes to this Project. Due to this, there may be items listed in the Products section that are not required under the scope of this contract.

C. Products required by the drawings but not listed in Part 2, will be evaluated as a performance specification based on the information provided on the Drawings.

2.2 CABLES

A. General
1. All cables on this Project shall be color-coded. Refer to Division 27 Section “Identification for Communications”.
2. CMP (OFNP) and CMR (OFNR) references below are as required by the NEC published by the National Fire Protection Association.
a. Cables not specifically identified otherwise, shall be provided with CMP classification.
b. Exceptions:
1) Cables run end-to-end within a completely closed conduit system.
2) Proper cable classification is ultimately determined by building construction; reductions in classification for cables, not clarified or altered by addendum to the specifications, shall require a contract cost deduction through a change order.

B. Twisted Pair Cables
1. Electrical Requirements:
a. All Twisted Pair cable is required to have the appropriate Category classification as defined by EIA/TIA/ANSI 568B. The compliance to these electrical characteristics must be third party verified by the manufacturer. Part 1 of this specification Section will define the appropriate Category for each cable.
b. Recognized Categories:
1) Category 1-2, Category 3, Category 5e, Category 6
2) All requirements and testing parameters as set forth by EIA/TIA 568B.
2. Construction
a. All Twisted pair cable will be properly constructed for the environmental conditions and to meet all applicable codes.
b. The following basic construction types are recognized for this Project:
1) Premise Distribution 4 pair Cables - Category 6
a) Fully ANSI/EI/TIA 568B.1 Category 6 compliant
b) Cable shall have 2 individual insulated 24 AWG solid copper conductors formed into a twisted pair.
c) Cable must be constructed of four individually insulated Unshielded Twisted Pairs (UTP)
d) The cable construction must be available in plenum (CMP) and non-plenum riser (CMR) rated constructions.
e) This cable construction is used in indoor pathways primarily as horizontal cabling but may also be used as backbone cable.
f) Basis of Design shall be as manufactured by Panduit CMP (Confirm Color with CML)
(A) Additionalapproved manufacturer(s): Berk-Tek, Commscope, Mohawk

2.3 TERMINATION HARDWARE

A. General
1. Suggested layout of termination hardware is indicated on the Drawings. Coordinate layout of termination hardware with the Owner’s Representative or Consultant/Architect/Engineer before installation.
2. Provide one single manufacturer for all twisted-pair termination hardware used together in a permanent link or whenever a Category Certification is required.

3. Termination devices on this Project shall be color-coded. ****See Detail
4. Drawings for details.
5. The manufacturer of the cable and the manufacturer of the connectivity products shall have a partnership agreement established in order to provide the required warranty. See Warranty requirements above and in related Section 27 00 01.00.
6. All devices shall be UL listed as required by the NEC published by the National Fire Protection Association.
7. All RJ-45 twisted pair termination devices are required to have the appropriate Category classification as defined by EIA/TIA/ANSI 568B. The compliance to these electrical characteristics must be third party verified by the manufacturer. Part 1 of this specification Section will define the appropriate Category for each cable.
    a. Recognized Categories:
        1) Category 1-2, Category 3, Category 5e, Category 6, Category 6a.
        2) All requirements and testing parameters as set forth by the latest update to EIA/TIA 568B.

B. Station Outlet
1. The following basic termination devices are available and recognized for this Project.
    a. Flush Faceplate – Single Gang Stainless Steel
        1) Single gang
        2) One Decora style opening
        3) 302 grade Stainless Steel
        4) Mountable on an outlet box, bracket, or raceway.
        5) Compatible with Decora Style Module Jack Frames specified herein.
        6) Basis of Design shall be Leviton 84401-040
            a) Additional approved manufacturers: Hubbell, Ortronics, Panduit
    b. Flush Faceplate – Double Gang Stainless Steel
        1) Double gang
        2) Two Decora style openings
        3) 302 grade Stainless Steel
        4) Mountable on an outlet box, bracket, or raceway.
        5) Compatible with Decora Style Module Jack Frames specified herein.
        6) Basis of Design shall be Leviton 84409-40
            a) Additional approved manufacturers: Hubbell, Ortronics, Panduit
    c. Furniture Faceplate
        1) Confirm item compatibility with Furniture Manufacturer On-Site
        2) 4 standard modular jack cutouts.
        3) Designed to snap into furniture knock-out.
        4) Basis of Design shall be Panduit CFFPL4BL
            a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics
    d. Flush Faceplate – Single Gang
        1) Executive faceplate Frame
        2) Four position minimum on each faceplate
        3) Confirm color to match adjacent electrical devices; White color unless otherwise specified
        4) Mountable on an outlet box, bracket, or raceway.
        5) Compatible with module inserts specified herein.
        6) Basis of Design shall be Panduit CFPE4xxY
            a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics
    e. Flush Faceplate – Double Gang
        1) Executive faceplate Frame
        2) Ten position minimum on each faceplate
        3) Confirm color to match adjacent electrical devices; White color unless otherwise specified
        4) Mountable on an outlet box, bracket, or raceway.
        5) Compatible with module inserts specified herein.
        6) Basis of Design shall be Panduit CFPE10xx-2GY
            a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics
    f. Decora Style Module Jack Frame
        1) Four position minimum on each frame

2) Confirm color to match adjacent electrical devices; White color unless otherwise specified
3) Mountable on an outlet box, bracket, or raceway.
4) Compatible with faceplates containing Decora style cut-out
5) Basis of Design shall be Panduit CFG4xx
a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

g. Duplex Module Quad Jack Frame
1) Four position minimum on each frame
2) Confirm color to match adjacent electrical devices; White color unless otherwise specified
3) Mountable on an outlet box, bracket, or raceway.
4) Compatible with faceplates containing standard electrical duplex receptacle cut-out.
5) Basis of Design shall be Panduit CF1064xxY
a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

h. Faceplate Blank Insert
1) Provide blanks for all un-used positions in faceplates, surface boxes, or jack frames.
2) Color to match outlet faceplate as described above; White color unless otherwise specified
3) Basis of Design shall be Panduit CMBxx-X
a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

i. Wall-Phone Jack
1) Stainless Steel faceplate with mounting posts for keyhole slot telephone mounting
2) Mountable on an outlet box, bracket, or raceway.
3) Basis of Design shall be Panduit KWP6PY
a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

j. F style bulkhead Insert
1) Female to Female 75 ohm bulkhead connector.
2) Color to match outlet faceplate as described above; White color unless otherwise specified
3) Basis of Design shall be Panduit CMFSRxxY
a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

C. Communications Room Equipment Rack(s)
1. The following basic termination devices are available and recognized or this Project.
a. UTP Cat 6 Patch Panel 24 port
1) Panel shall be black steel with PCB connection between interfaces
2) Shall provide 24 ports in 1.75” of rack space (1 RU).
3) Designed with jack labeling areas on both front and rear
4) Fully compliant ANSI/TIA/EIA 568B Category 6
5) RJ45 jack interface on front and 110 style IDC connections on rear
6) Mountable in EIA standard 19” rack/cabinet rails.
7) Basis of Design shall be Panduit DP24688TGY
a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

b. UTP Cat 6 Patch Panel 48 port
1) Panel shall be black steel with PCB connection between interfaces
2) Shall provide 48 ports in 3.5” of rack space (2 RU).
3) Designed with jack labeling areas on both front and rear
4) Fully compliant ANSI/TIA/EIA 568B Category 6
5) RJ45 jack interface on front and 110 style IDC connections on rear
6) Mountable in EIA standard 19” rack/cabinet rails.
7) Basis of Design shall be Panduit DP48688TGY
a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

c. 110 Block Mounting Panel
1) Panel shall be black steel pre-drilled for mounting standard 110 style devices and trough hardware Mountable in 4 rack spaces (7.00”) EIA standard 19” rack/cabinet rails.
2) Must use separate 110 style blocks and hardware listed under Wall Mounted Terminations below – Order without legs.
3) Basis of Design shall be Panduit P110B100R4BY

a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

d. 110 style 100 pair base
   1) Shall utilize Industry normal footprint
   2) Must have labeling areas on front and available label kits
   3) Fully compliant ANSI/TIA/EIA 568B Category 5e
   4) 110 style IDC termination system
   5) Optional jumper troughs available and designed to mount with base footprint
   6) Requires 110C connecting blocks below
   7) Available without legs for mounting on rack/cabinet mounted panels or on Tower Systems
   8) Basis of Design shall be Panduit P110BW100-X with legs and Panduit P110B100-X without legs
      a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

e. 110 style 300 pair base
   1) Shall utilize Industry normal footprint
   2) Must have labeling areas on front and available label kits
   3) Fully compliant ANSI/TIA/EIA 568B Category 5e
   4) 110 stye IDC termination system
   5) Optional jumper troughs available and designed to mount with base footprint
   6) Requires 110C connecting blocks below
   7) Available without legs for mounting on rack/cabinet mounted panels or on Tower Systems
   8) Basis of Design shall be Panduit P110BW300-X with legs and Panduit P110B300-X without legs
      a) Additionalapproved manufacturers: Hubble, Leviton, Ortronics

f. 110 style connecting Block – 4 pair
   1) Fully compliant ANSI/TIA/EIA 568B Category 5e 110 stye IDC termination system
   2) Used for termination of 4 pair cables or a combination of 4 pair and multi-pair cables
   3) Basis of Design shall be Panduit P110CB4-XY
      a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

g. 110 style connecting Block – 5 pair
   1) Fully compliant ANSI/TIA/EIA 568B Category 5e
   2) 110 stye IDC termination system
   3) Used for termination of multi-pair cables
   4) Requires 110C connecting blocks below
   5) Basis of Design shall be Panduit P110CB5-XY
      a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

h. 110 style Jumper Trough with legs
   1) Used for wire management around 110 style termination bases
   2) Available without legs for mounting on rack/cabinet mounted panels or on Tower Systems
   3) Basis of Design shall be Panduit P110JTW-X with legs and P110JT-X without legs
      a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

D. Discrete Cable Connectors
   1. The following basic termination devices are available and recognized on this Project:
      a. Category 6 RJ-45 modular plug for solid cable.
         1) Each plug will use an insulation displacement pressure termination method with specifically designed installation tool.
         2) The plug shall be 8 position; 8 conductor.
         3) Designed for 23 gauge solid copper conductors.
         4) The strain relief of the plug shall be designed for clamping on round cable.
         5) Basis of Design shall be Panduit SP688-C
            a) Additionalapproved manufacturers: Hubbell, Leviton, Ortronics

PART 3 - EXECUTION

3.1 GENERAL

A. This section is designed to provide a Basis of Design and functionality for the installation of technology systems infrastructure. Not all procedures will be necessary for the installation of this Project; however, this standard shall be considered in force for the original response as well as for any additions or changes to this Project.

3.2 INSTALLATION

A. Coordination
   1. Review and coordinate proper pathways prior to installation.
   2. Reference the TELECOMMUNICATIONS DISTRIBUTION METHODS MANUAL (TDMM) published by the Building Industry Consulting Services International (BICSI) for cable installation practices. This Specification may take exception to optional statements within the TDMM. Treat any conflict per this Specification under discrepancies or Conflicts.

B. General
   1. Cable routing shall follow building structure lines and shall be installed with adequate length to reach to any location within the equipment racks with at least 5 feet of service loop at each end.
   2. At point of final terminations, excess cable and the service loop shall be stored and dressed neatly.
      a. At the station end of the cable the service loop shall be stored above the ceiling line at an accessible point and supported with an approved device designed for that purpose.
      b. Within a communications room the service loop shall be dressed and stored within the ladder rack.
   3. Provide strain relief at all connection points. Strain relief techniques shall be applied to all cables to lessen the risk of physical cable damage and to provide proper aesthetic value.
   4. Route all cabling and pathways parallel to building surfaces and at 90 degree angles to the building structure.
   5. Cable runs shall be continuous and without splices.
   6. Wiring shall be free from grounds, shorts, opens, and reversals.

C. Protection
   1. Maintain protection of all cabling throughout the entire duration of the project.
   2. Cabling shall not be left hanging or coiled where it potentially obstructs the Work of other contractors or trades. Cabling shall be bundled, supported, and protected up out of the way of other trades any time it is determined necessary to ensure the safety of personnel or protection of the cable.
   3. Do not terminate cables designated for different services onto the same patch panel unless otherwise clearly indicated on the drawings.
   4. Do not exceed minimum bend radius or pulling tension specifications set forth by the product manufacturer.
   5. Cable Separation and Organization
      a. Cables of different services shall not be intertwined.
      b. Cables of all service types shall be organized and kept segregated within cable trays, ladder rack, wire management and other pathways.
      c. Terminate all cabling on specified termination hardware in numerical order and on specified outlets.

D. Labeling
   1. Every cable shall have a label applied to the jacket at each end.
   2. Each terminating device and port shall have a unique identifier.
   3. Label all cabling and terminations as specified and indicated on related drawings.

E. Raceways
   1. Install cabling within conduit or in surface raceway where specified in this or related sections or as indicated on the drawings.
      a. Surface raceway is permissible for use only where expressly indicated on the drawings.

2. Cabling shall be installed in a concealed manner. Cables may be visible only in the following areas. (Provide concealed rough-ins for all device and outlet locations.)
   a. Equipment Rooms
   b. Telecommunications Rooms
   c. Building spaces equipped with cable trays but without finished ceilings to conceal the cables.
3. Install cabling in cable tray and ladder rack where specified in this or related sections or as indicated on the drawings.
4. Support cables using approved products and methods whenever conduit, surface raceway or cable tray are not specified. Cable supports shall be attached directly to building structure.
5. Entry/exit from raceways shall be made in a uniform and consistent manner and shall not exceed the minimum bend radius of the cable.
6. Route all cabling and pathways parallel or at 90 degree angles to the structure.
7. Support cabling with the appropriate cable supports and from the building structure.

F. Wall and Floor Penetrations
1. Provide conduit sleeves with bushings on each end for all cabling penetrations. Split bushings shall not be permitted. Patch and firestop around the sleeve. Firestop the interior of the sleeve after cable is installed.
2. Firestop all firewall penetrations to return the wall to its original rating. Outlet boxes installed in firewalls shall be similarly firestopped.

G. Cable Supports
1. Neatly dress, support and securely attach all cabling on backboards and in equipment racks.
2. Where cabling is not supported by cable tray or conduit, provide necessary cable support as specified. Provide nylon cable tie at the support to contain cabling within the support. Do not bundle cable between supports. Provide cable support as specified at intervals not to exceed 5 feet. Do not secure cabling to the support. Do not use cable supports with round surfaces (i.e. bridal rings).
3. Route all cabling and pathways parallel or at 90 degree angles to the structure. Support cabling with the appropriate cable supports and from the building structure.

H. Termination
1. Terminate each end of every cable per the manufacturer's printed instructions.
2. Terminate each cable in numerical order on adjacent ports on the specified termination hardware within the appropriate communications room.
3. Terminate cables using the tools and connectors specified and as recommended by the cable/connector manufacturers' printed instructions.

I. Separation from Sources of Interference
1. Route cables at least 1.2m (4 foot) from motors or transformers; 30 cm (1 foot) from conduit and cables used for AC power distribution; 12 cm (5 inches) from fluorescent lighting fixtures.

J. Horizontal cabling
1. The length of patch cords and cross connect jumpers installed in the Telecommunications Room shall be 5 m (15 ft) total or less.
2. The length of patch cords and cross connect jumpers installed in the Equipment
3. Room shall be 5 m (15 ft) total or less.
4. Locate telecommunications outlets so that the cable assembly required to reach work area equipment will be no more than 5 m (15 ft) long.
5. Provide service loops on all cables at the station end of 2 feet (coiled above the ceiling and with a minimum of 6 inches at the telecommunications outlet coiled in the box or raceway.
6. Provide service loop at the Equipment Room/Telecommunications Room end of 5 feet coiled above the ceiling or neatly bundled in ladder rack above the cabinet/rack.
7. Install telecommunications outlets securely at work area locations.
8. Any necessary electrical components (e.g., impedance-matching devices) at outlets shall be located outside the faceplate via a standard plug connection.
9. Provide surface raceway on all walls where existing pathway has not been provided and cables cannot be concealed inside the wall cavity. Do not conceal cabling inside of block walls. Install

surface raceway plumb and level, straight and securely anchored to walls with screws, bolts, or anchors as appropriate.

10. Provide a 6 inch service loop on each horizontal UTP cable that breaks out from the harness for termination and do not violate the minimum bend radius of the cable.

3.3 TESTING

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

E. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

F. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

G. End-to-end cabling will be considered defective if it does not pass tests and inspections.
1. Prepare test and inspection reports.

H. The Owner reserves the right to have a representative present during any or all testing procedures. Verification testing of copper and fiber may be performed at or near Project completion by the Consultant for quality assurance.

I. Upon verification testing, if the Consultant finds the test results do not match the Contractor’s results, the Consultant or a third party may at the Owner’s request retest all of the cabling and submit those results to the Owner and deduct the verification testing costs from the Contractor’s Contract amount.

END OF SECTION 27 15 13

SECTION 27 33 00

PUBLIC ADDRESS SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish a complete Public Address (PA) system in accordance with the plans and as specified herein. The contractor shall install all speakers, horns, cables and cable to be run to the main communications room. The Contractor shall make all connections and install all equipment in the communications room. The Contractor shall coordinate exact equipment mounting locations with the Owner prior to the installation of any equipment or cabling.

1.2 QUALITY ASSURANCE

A. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, regulations, and the requirements of the authorities having jurisdiction.

B. Comply with NFPA 70.

C. Listing and Labeling: Provide PA system components specified in this Section that are listed and labeled by Underwriters' Laboratories, Inc. (UL).

D. PA System shall be registered under Part 68 of the Federal Communications Commission (FCC).

1.3 SUBMITTALS

A. Submit product data for each type of proposed system component specified, including dimensioned drawings showing minimum clearances and installed features and devices. Include list of materials and NRTL-listing data.

B. Submit Shop Drawings showing detailed drawings of PA system.

C. Submit wiring diagrams from manufacturer differentiating clearly between factory and field-installed wiring. Include diagrams for each component of the system with all terminals and interconnections identified. Make all diagrams specific to this Project.

D. Submit a system operation description covering this specific Project, including method of operation. Manufacturer's standard descriptions for generic systems are unacceptable.

E. Submit product certificates signed by the manufacturer of the PA system components certifying that their products comply with specified requirements.

F. Submit the manufacturer’s warranty.

1.4 DELIVERY, HANDLING, AND STORAGE

A. Deliver PA system components in factory fabricated containers or wrappings, which properly protect products from damage.

B. Handle PA system components carefully to prevent breakage, denting and scoring finish. Wrap finished cabinets individually, in heavy containers for protection in transit. Do not install damaged units or components; replace with new.

C. Store PA system components in original cartons in well ventilated space protected from moisture, construction traffic and debris.

1.5 SEQUENCE OF OPERATION

A. The PA system shall be zone based for direct connection to loop start and ground start trunks, to PBX and KEY paging ports that supplies DTMF capability and to analog T/R lines.

B. The system shall allow total amplifier power up to 250W.

C. Momentary tones shall be placed throughout the system when a contact closure is received from the master clock of the building automation system.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Subject to compliance with requirements, provide the following equipment including, but not limited to, the following:
1. Bogen PCM 2000 series (Basis of design)

2.2 Zone Paging Modules

A. All modules shall be equipped with a ribbon cable, connector and power cable for interconnection to each other. Module face plates shall be black with connector types labeled in white. Each plate shall have knockouts for cabling and wire dressing. All connectors shall be RJ-11 or RCA type.

B. Telephone interface module shall have LED power indicator and provide interface selection via DIP switches and include volume control for tone and BGM source. It shall also have RJ-11 outlets for night ringer, telephone line and override functions. A connector block with screw terminal connections shall be provided for BGM source and 2 form-C relay contacts.

C. Central Processor Module (CPU) shall be provided for the first 9 zones of the system. CPU shall provide satellite system identification via DIP switches. It shall include a locking program/run selector switch (with LED), satellite data link RCA jack and 12VDC power source. A connector block with screw terminals shall be provided for paging amplification connections, low and high power BGM connections, emergency/shift change signal activation, AUX contact closure and 12VDC power source.

D. A talkback module (PCMTBM) shall be provided for hands-free talkback capability.

E. The Zone PA system shall have the following functions:
1. Simultaneous high and low power paging.
2. Minimum of 3 paging zones and maximum capacity of 99 zones, expandable in groups of 3 zones.
3. Up to 32 field programmable zone groups, each consisting of 1 – 99 zones.
4. Field programmable night ringer zone group.
5. Field programmable emergency/shift change zone group. This feature shall be activated by a Owner supplied contact closure and sound a user-selected tone.
6. Emergency all-facility page override.
7. Background music with local music sourcing capability.

8. Field programmable Code Call Zone Group. Owner shall have choice of pattern or echo code calls and repeat functions.
9. 2 Form-C relay contactors for activating external equipment.
10. Provide uninterrupted background music to zones not being paged.
11. Non-volatile RAM for retention of programming information during power interruptions.
12. Screwdriver adjustable volume controls.

F. VOIP tie in module to enable access from IP phone system to paging system. Coordinate with Owner's phone system vendor.

G. All modules shall be wall mountable.

2.3 EQUIPMENT

A. Rack
1. Provide equipment in data racks as specified in Section 27 11 16 "Communications Cabinets, Racks, Frames and Enclosures".

B. Drop in Ceiling Tile Speakers
1. UL listed, shallow depth lightweight speaker assembly, 1' x 2' ceiling tile loudspeaker system consisting of 8" O.D. dual cone loudspeaker with 5 oz. magnet and 5W-25/70V transformer.
2. Quam 8C5PAX/TBLU or approved equal by Rauland or Atlas.

C. Cabling
1. Speaker cabling shall be plenum rated, 2-conductors twisted pair, 18 gauge stranded copper.
2. West Penn 25224B or approved equal by General or Belden.

PART 3 - EXECUTION

3.1 Installation, General

A. Install system according to standards referenced in Part 1 of this Section.

3.2 Equipment Installation

A. Install ceiling/wall mounted speakers and other equipment per manufacturer's recommendation.

B. Flush wall mount volume controller as required.

3.3 Wiring Installation

A. Wiring Method: Install paging system wiring in metal conduit where concealed and inaccessible, such as within walls and enclosed ceilings. Wiring above accessible ceilings may be routed in J-hooks. Where low voltage cable tray is available, speaker cables can be routed within.

B. Final termination in the main communications room will be by the Contractor.

C. Speaker circuits shall be designed not to exceed a 5 percent voltage drop.

3.4 Identification

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section “Identification for Electrical Systems."

3.5 Grounding

A. Ground equipment according to system manufacturer's instructions to eliminate shock hazard and to minimize, to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments.

B. Ground equipment, conductor and cable shields. For audio circuits, minimize, to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments.

3.6 Field Quality Control

A. Minimum System Tests: The minimum required tests are as follows:
   1. Verify the absence of unwanted voltages between circuit conductors and ground.
   2. Test all conductors for short circuits using an insulation-testing device.
   3. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.

B. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests. A copy of the test reports shall be included in the Owner's O&M Manual.

C. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

END OF SECTION 27 33 00

SECTION 28 13 00

ACCESS CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Security access control station.
2. Security access networked workstations.
3. Security access operating system and application software.

1.2 DEFINITIONS

A. CCTV: Closed-circuit television.

B. CPU: Central processing unit.

C. Credential: Data assigned to an entity and used to identify that entity.

D. dpi: Dots per inch.

E. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.

F. GFI: Ground fault interrupter.

G. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

H. I/O: Input/Output.

I. LAN: Local area network.

J. Location: A Location on the network having a PC-to-controller communications link, with additional controllers at the Location connected to the PC-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.

K. PC: Personal computer. Applies to the central station, workstations, and file servers.

L. PCI Bus: Peripheral Component Interconnect. A peripheral bus providing a high-speed data path between the CPU and the peripheral devices such as a monitor, disk drive, or network.

M. PDF: Portable Document Format. The file format used by the Acrobat document-exchange-system software from Adobe.

N. RAS: Remote access services.

O. RF: Radio frequency.

P. ROM: Read-only memory. ROM data are maintained through losses of power.

Q. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

R. TWAIN: Technology without an Interesting Name. A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.

S. UPS: Uninterruptible power supply.

T. USB: Universal serial bus.

U. WAN: Wide area network.

V. WAV: The digital audio format used in Microsoft Windows.

W. WMP: Windows media player.

X. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

Y. Windows: Operating system by Microsoft Corporation.

Z. Workstation: A PC with software that is configured for specific, limited security-system functions.

AA. WYSIWYG: What You See Is What You Get. Text and graphics appear on the screen the same as they will in print.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data shall comply with SIA BIO-01.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Diagrams for cable management system.
   2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
   3. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:
      a. Workstation outlets, jacks, and jack assemblies.
      b. Patch cords.
      c. Patch panels.
   4. Cable Administration Drawings: As specified in "Identification" Article.
   5. Battery and charger calculations for central station, workstations, and controllers.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Microsoft Windows software documentation.
   2. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
   3. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.

4. System installation and setup guides with data forms to plan and record options and setup decisions.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses of all kinds, power and electronic, equal to 10 percent of amount installed for each size used, but no fewer than three units.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
   1. Cable installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.

B. Source Limitations: Obtain central station, workstations, controllers, Identifier readers, and all software through one source from single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70, "National Electrical Code."

E. Comply with SIA DC-01 and SIA DC-03 and SIA DC-07.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Central Station, Workstations, and Controllers:
   1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, noncondensing.
   2. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.
   3. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.
   4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   1. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
   2. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except the central-station control unit, installed in temperature-controlled indoor environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products by the following:
   1. Lenel (OnGuard)
   2. Interlogix (truPortal)
   3. or Owner approved equal.

2.2 DESCRIPTION

A. Security Access System: Field-installed controllers, connected by a high-speed electronic-data transmission network.

B. System Software: Based on 32-bit central-station, Windows workstation operating system, server operating system, and application software. Software shall have the following capabilities:
   1. Multiuser and multitasking to allow for independent activities and monitoring to occur simultaneously at different workstations.
   2. Graphical user interface to show pull-down menus and a menu-tree format that complies with interface guidelines of Microsoft Windows.
   3. System license for the entire system including capability for future additions that are within the indicated system size limits specified in this Section.
   4. Open-architecture system that allows importing and exporting of data and interfacing with other systems that are compatible with Microsoft Windows.
   5. Password-protected operator login and access.
   6. Open-database-connectivity compliant.

C. Network connecting the central station and workstations shall be a LAN using Microsoft Windows-based TCP/IP with a capacity of connecting up to 99 workstations. System shall be portable across multiple communication platforms without changing system software.

D. Controllers shall consist of one or more of the following:
   1. Local area, IEEE 802.3 Gigabit-Ethernet, star topology network based on TCP/IP.
   2. Dialer using standard telephone line.

2.3 OPERATION

A. Security access system shall use a single database for access-control and credential-creation functions.

B. Distributed Processing: A fully distributed processing system.
   1. Access-control information, including time, date, valid codes, access levels, and similar data, shall be downloaded to controllers so each controller can make access-control decisions.
   2. Intermediate controllers for access control are prohibited.
   3. In the event that communications with the central controller are lost, controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the central station.

C. Number of Locations:
   1. Support at least for 2500 readers, 10,000 inputs and outputs, 500,000 personnel records, 100 simultaneous client connections and 10 badging clients.
   2. Each Location shall have its own database and history in the central station.
   3. Locations may be combined to share a common database.

D. Data Capacity:
   1. 120 different card-reader formats.
   2. 999 comments.
   3. Support for Raster and Vector graphic file types for importing maps.

E. Location Capacity:
   1. 128 reader-controlled doors.
   2. 50,000 total-access credentials.
   3. 2048 supervised alarm inputs.
   4. 2048 programmable outputs.
   5. Ability to create Predefined Log Messages. These messages may be assigned to any event providing the ability to select the appropriate response during event management process. The SMS provides the ability to group multiple log messages and then assign the group to an event. Each group may contain up to one hundred messages and each event supports up to one hundred predefined log messages..

F. System Network Requirements:
   1. System components shall be interconnected and shall provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
   2. Communication shall not require operator initiation or response and shall return to normal after partial- or total-network interruption such as power loss or transient upset.
   3. System shall automatically annunciate communication failures to the operator and shall identify the communications link that has experienced a partial or total failure.
   4. Communications controller may be used as an interface between the central-station display systems and the field device network. Communications controller shall provide functions required to attain the specified network communications performance.

G. Central station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central station shall control system networks to interconnect all system components, including workstations and field-installed controllers.

H. Field equipment shall include controllers, sensors, and controls.
   1. Controllers shall serve as an interface between the central station and sensors and controls.
   2. Data exchange between the central station and the controllers shall include down-line transmission of commands, software, and databases to controllers.
   3. The up-line data exchange from the controller to the central station shall include status data such as intrusion alarms, status reports, and entry-control records.
   4. Controllers are classified as alarm-annunciation or entry-control type.

I. System Response to Alarms:
   1. Field device network shall provide a system end-to-end response time of one second(s) or less for every device connected to the system.
   2. Alarms shall be annunciated at the central station within one second of the alarm occurring at a controller or at a device controlled by a local controller, and within 100 ms if the alarm occurs at the central station.
   3. Alarm and status changes shall be displayed within 100 ms after receipt of data by the central station.
   4. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within five seconds of alarm receipt at the security console.
   5. This response time shall be maintained during system heavy load.

J. False-Alarm Reduction: The design of the central station and controllers shall contain features to reduce false alarms. Equipment and software shall comply with UL 1076.

K. Error Detection:
   1. TCP/IP tools that employs sequence numbers and acknowledgments to cover discarding duplicate packets, retransmission of lost packets, and ordered-data transfer. To assure correctness a checksum field is included and an operator assignable two digit decimal number for each communication link representing the number of retransmission attempts is not supported..
   2. Interactive or product error-detection codes alone will not be acceptable.
   3. A message shall be in error if one bit is received incorrectly.
   4. Retransmit messages with detected errors.
   5. Allow for an operator-assigned two-digit decimal number to each communications link representing the number of retransmission attempts.

6. Central station shall print a communication failure alarm message when the number of consecutive retransmission attempts equals the assigned quantity.
7. Monitor the frequency of data transmission failure for display and logging.

L. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.

M. Door Hardware Interface:
1. Comply with requirements in Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)" for door hardware required to be monitored or controlled by the security access system.
2. Electrical characteristics of controllers shall match the signal and power requirements of door hardware.

2.4 APPLICATION SOFTWARE

A. System Software: Based on 32-bit, Microsoft Windows central-station and workstation operating system and application software.

B. Software House C•CURE 9000 (no exception). System software shall provide full fault tolerance to multi-processor applications that require 100% uptime. It combines the physical resources of two standard Windows servers into a single operating environment with complete redundancy of all underlying hardware and data. It presents these redundant servers as a single operating environment to keep the C•CURE 9000 running in the event of component or system failures. Software shall manage the two physical host machines such that critical host failures on either server will still result in application (C•CURE 9000) availability via the redundant host. Application availability is not affected during failover instances and users should not notice any transition to the redundant host. Conversely, any return to normal operation should equally go unnoticed and no loss of performance will be caused in either instance.

C. Application Software: Interface between the alarm annunciation and entry-control controllers to monitor sensors, operate displays, report alarms, generate reports, and help train system operators.
1. Reside at the central station, workstations, and controllers as required to perform specified functions.
2. Operate and manage peripheral devices.
3. Manage files for disk I/O, including creating, deleting, and copying files; and automatically maintain a directory of all files, including size and location of each sequential and random-ordered record.
4. Import custom icons into graphics to represent alarms and I/O devices.
5. Globally link I/O so that any I/O can link to any other I/O within the same Location without requiring interaction with the host PC. This operation shall be at the controller.
6. Globally code I/O links so that any access-granted event can link to any I/O with the same Location without requiring interaction with the host PC. This operation shall be at the controller.
7. Messages from PC to controllers and controllers to controllers shall be on a polled network that utilizes check summing and acknowledgment of each message. Communication shall be automatically verified, buffered, and retransmitted if message is not acknowledged.
8. Network ready controller providing user configurable timing intervals for verifying connections from the host to the master controller.
9. Operator audit trail for recording and reporting all changes made to database and system software.
10. TCP/IP communications over LAN or WAN. VPN access capable.

D. Workstation Software:
1. Operator access to various functions and operations in the CCURE9000 Administration and Monitoring Client applications are based on the configuration of the operator’s privilege. CCURE9000 supports an unlimited number of privileges, where the same privilege can be assigned to multiple operators.

E. Controller Software:
1. Controllers shall operate as autonomous, intelligent processing units.

a. Controllers shall make decisions about access control, alarm monitoring, linking functions, and door-locking schedules for their operation, independent of other system components.
b. Controllers shall be part of a fully distributed processing-control network.
c. The portion of the database associated with a controller, and consisting of parameters, constraints, and the latest value or status of points connected to that controller, shall be maintained in the controller.

2. The following functions shall be fully implemented and operational within each controller:
   a. Monitoring inputs.
   b. Reporting of sensor and output status to the central station on request.
   c. Maintaining real time, automatically updated by the central station at least once a day.
   d. Communicating with the central station.
   e. Executing controller resident programs.
   f. Diagnosing.
   g. Downloading and uploading data to and from the central station.
3. Controller Operations at a Location:
   a. Up to 64 controllers connected to TIA 485-A communications loop. Globally operating I/O linking and anti-passback functions between controllers within the same Location without central-station or workstation intervention. Linking and anti-passback shall remain fully functional within the same Location even when the central station or workstations are off-line.
4. Individual Controller Operation:
   a. Controllers shall transmit alarms, status changes, and other data to the central station when communications circuits are operable. If communications are not available, controllers shall function in a stand-alone mode; operational data, including the status and alarm data normally transmitted to the central station, shall be stored for later transmission to the central station. Storage capacity for the latest 1024 events shall be provided at each controller.
   b. Card-reader ports of a controller shall be custom configurable for at least 10 different card formats.
   c. Controllers shall provide a response to card readers or keypad entries in less than 0.25 seconds, regardless of system size.
   d. Controllers that are reset, or powered up from a nonpowered state, shall automatically request a parameter download and reboot to their proper working state. This shall happen without any operator intervention.
   e. Initial Startup: When controllers are brought on-line, database parameters shall be automatically downloaded to them. After initial download is completed, only database changes shall be downloaded to each controller.
   f. On failure for any reason, controllers shall perform an orderly shutdown and force controller outputs to a predetermined failure-mode state, consistent with the failure modes shown and the associated control device.
   g. After power is restored, following a power failure, startup software shall initiate self-test diagnostic routines, after which controllers shall resume normal operation.
   h. After controller failure, if the database and application software are no longer resident, controllers shall not restart but shall remain in the failure mode until repaired. If database and application programs are resident, controllers shall immediately resume operation. If not, software shall be restored automatically from the central station.
5. Communications Monitoring:
   a. System controller communicates to server via TCP/IP and monitors the supervision of associated field equipment such as RM and I/O modules via 2 wire RS-485 protocol. Triggers can be configured to activate events when any module is in communication failure
6. Operating systems shall include a real-time clock function that maintains seconds, minutes, hours, day, date, and month. The real-time clock shall be automatically synchronized with the central station at least once a day to plus or minus 10 seconds. The time synchronization shall be automatic, without operator action and without requiring system shutdown.

F. PC-to-Controller Communications:
1. System shall utilize a single, industry-standard relational database management system for the storage and manipulation of related data. The system includes a server with operating system and applications software, operator and administrator terminals with appropriate software, hard copy printers and fixed magnetic storage media. The system client workstations and controller

communicate to the application server via TCP/IP over Ethernet. Other third party field devices may communicate to server Ethernet 10/100 or a serial (RS-232, RS-485) connection.

G. Database Downloads:
1. System controller performs a “Fast Personnel Download” when initial communications to controller is established. All new, deleted and modified records are immediately downloaded to the controller as they are committed. No manual download process is required.
2. Controller provides an onboard Ethernet connection and supports a PCMCIA Ethernet card as a secondary communication path.

H. Operator Interface:
1. System supports the placement of an icon representing an event that may be configured to change the status of multiple objects.

I. Operator Access Control:
1. Operator access to various functions and operations in the system Administration and Monitoring Client applications are based on the configuration of the operator’s privilege. The system supports an unlimited number of privileges, where the same privilege can be assigned to multiple operators.

J. Operator Commands:
1. The system allows devices to be placed in an offline state to facilitate the phased deployment and testing of remote field devices.

K. Alarms:
1. System Setup:
   a. Assign manual and automatic responses to incoming-point status change or alarms.
   b. Automatically respond to input with a link to other inputs, outputs, or operator-response plans; unique sound with use of WAV files; and maps or images that graphically represent the point location.
   c. Sixty-character message field for each alarm.
   d. Operator-response-action messages shall allow message length of at least 65,000 characters, with database storage capacity of up to 32,000 messages. Setup shall assign messages to access point, sensor.
   e. Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator.
   f. Allow 25 secondary messages with a field of four lines of 60 characters each.
   g. Store the most recent 1000 alarms for recall by the operator using the report generator.
2. Software Tamper:
   a. Annunciate a software tamper alarm when an operator or other individual makes three consecutive unsuccessful attempts to invoke functions beyond the authorization level.
   b. Maintain a transcript file of the last 5000 commands entered at each central station to serve as an audit trail. System shall not allow write access to system transcript files by any person, regardless of their authorization level.
   c. Allow only acknowledgment of software tamper alarms.
3. Read access to system transcript files shall be reserved for operators with the highest password authorization level available in system.
4. Animated Response Graphics: Highlight alarms with flashing icons on graphic maps; display and constantly update the current status of alarm inputs and outputs in real time through animated icons.
5. Multimedia Alarm Annunciation: WAV files to be associated with alarm events for audio annunciation or instructions.
6. Alarm Handling: Each input may be configured so that an alarm cannot be cleared unless it has returned to normal, with options of requiring the operator to enter a comment about disposition of alarm. Allow operator to silence alarm sound when alarm is acknowledged.
7. Alarm Automation Interface: High-level interface to central-station alarm automation software systems. Allows input alarms to be passed to and handled by automation systems in the same manner as burglar alarms, using a TIA 232-F ASCII interface.
8. CCTV Alarm Interface: Allow commands to be sent to CCTV systems during alarms (or input change of state) through serial ports.
9. Camera Control: Provides operator ability to select and control cameras from graphic maps.

L. Alarm Monitoring: Monitor sensors, controllers, and DTS circuits and notify operators of an alarm condition. Display higher-priority alarms first and, within alarm priorities, display the oldest unacknowledged alarm first. Operator acknowledgment of one alarm shall not be considered acknowledgment of other alarms nor shall it inhibit reporting of subsequent alarms.
   1. Displayed alarm data shall include type of alarm, location of alarm, and secondary alarm messages.
   2. Printed alarm data shall include type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator responses.
   3. Maps shall automatically display the alarm condition for each input assigned to that map if that option is selected for that input location.
   4. Alarms initiate a status of "pending" and require the following two handling steps by operators:
      a. First Operator Step: "Acknowledged." This action shall silence sounds associated with the alarm. The alarm remains in the system "Acknowledged" but "Un-Resolved."
   5. Each workstation shall display the total pending alarms and total unresolved alarms.
   6. Each alarm point shall be programmable to disallow the resolution of alarms until the alarm point has returned to its normal state.
   7. Alarms shall transmit to the central station in real time except for allowing connection time for dial-up locations.
   8. Alarms shall be displayed and managed from a minimum of four different windows.
      a. Input Status Window: Overlay status icon with a large red blinking icon.
      b. History Log Transaction Window: Display name, time, and date in red text.
      c. Alarm Log Transaction Window: Display name, time, and date in red.
      d. Graphic Map Display: Display a steady colored icon representing each alarm input location. Change icon to flashing red when the alarm occurs. Change icon from flashing red to steady red when the alarm is acknowledged.
   9. Once an alarm is acknowledged, the operator shall be prompted to enter comments about the nature of the alarm and actions taken. Operator's comments may be manually entered or selected from a programmed predefined list, or a combination of both.
   10. For locations where there are regular alarm occurrences, provide programmed comments. Selecting that comment shall clear the alarm.
   11. The time and name of the operator who acknowledged and resolved the alarm shall be recorded in the database.
   12. Identical alarms from the same alarm point shall be acknowledged at the same time the operator acknowledges the first alarm.
   13. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and controllers.
   14. When a reader-controlled output (relay) is opened, the corresponding alarm point shall be automatically bypassed.

M. Monitor Display: Display text and graphic maps that include zone status integrated into the display. Colors are used for the various components and current data. Colors shall be uniform throughout the system.
   1. Color Code:
      a. FLASHING RED: Alerts operator that a zone has gone into an alarm or that primary power has failed.
      b. STEADY RED: Alerts operator that a zone is in alarm and alarm has been acknowledged. (Changes to yellow when active event is acknowledged until event cause has expired).
      c. YELLOW: Advises operator that a zone is in access.
      d. GREEN: Indicates that a zone is secure and that power is on.
   2. Graphics:
      a. Support Raster and Vector graphic display maps and allow import of maps from standard formats from another drawing or graphics program.
      b. Allow I/O to be placed on graphic maps by the drag-and-drop method.
      c. Operators shall be able to view the inputs, outputs, and the point's name by moving the mouse cursor over the point on the graphic map.
      d. Inputs or outputs may be placed on multiple graphic maps.
      e. Camera icons shall have the ability to be placed on graphic maps that, when selected by an operator, will open a video window, display the camera associated with that icon, and provide pan-tilt-zoom control.
      f. Input, output, or camera placed on a map shall allow the ability to arm or bypass an input, open or secure an output, or control the pan-tilt-zoom function of the selected camera.

N. System test software enables operators to initiate a test of the entire system or of a particular portion of the system.
   1. Test Report: The results of each test shall be stored for future display or printout. The report shall document the operational status of system components.

O. Report-Generator Software: Include commands to generate reports for displaying, printing, and storing on disk and tape. Reports shall be stored by type, date, and time. Report printing shall be the lowest-priority activity. Report-generation mode shall be operator selectable but set up initially as periodic, automatic, or on request. Include time and date printed and the name of operator generating the report. Report formats may be configured by operators.
   1. Automatic Printing: Setup shall specify, modify, or inhibit the report to be generated; the time the initial report is to be generated; the time interval between reports; the end of the period; and the default printer.
   2. Printing on Request: An operator may request a printout of any report.
   3. Alarm Reports: Reporting shall be automatic as initially set up. Include alarms recorded by system over the selected time and information about the type of alarm such as door alarm, motion detector, door contact, etc.), the type of sensor, the location, the time, and the action taken.
   4. Access and Secure Reports: Document zones placed in access, the time placed in access, and the time placed in secure mode.
   5. Custom Reports: Reports tailored to exact requirements of who, what, when, and where. As an option, custom report formats may be stored for future printing.
   6. Automatic History Reports: Named, saved, and scheduled for automatic generation.
   7. Cardholder Reports: Include data, or selected parts of the data, as well as the ability to be sorted by name, card number, imprinted number, or by any of the user-defined fields.
   8. Cardholder by Reader Reports: Based on who has access to a specific reader or group of readers by selecting the readers from a list.
   9. Cardholder by Access-Level Reports: Display everyone that has been assigned to the specified access level.
   10. Provide an Area Muster feature and a default “Roll Call” report which display’s the list of personnel presently accessed to an area. Some modifications and/or customizations to the report may be made to include Area Access Time, etc.
   11. Panel Labels Reports: Printout of control-panel field documentation including the actual location of equipment, programming parameters, and wiring identification. Maintain system installation data within system database so that data are available on-site at all times.
   12. History Reports: Custom reports that allow the operator to select any date, time, event type, device, output, input, operator, Location, name, or cardholder to be included or excluded from the report.

P. Anti-Passback:
   1. System shall supports Areas with Anti-passback allowing for hard and timed Anti-passback as well as an Occupancy feature allowing for the setting of Minimum and Maximum occupancy. Soft anti-passback may be configured whereby certain cardholders may be flagged as exempt from anti-passback checking or configured to activate or not activate an anti-passback event. Anti-Passback is an iSTAR Area function (not at individual door level) and is supported at the Cluster and Cross Cluster (Global) level.

2.5 CONTROLLERS

A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the central station or workstation for controlling its operation.

B. Subject to compliance with requirements in this article, manufacturers may use multipurpose controllers.

C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 24 hours.

D. Alarm Annunciation Controller:
   1. The controller shall automatically restore communication within 10 seconds after an interruption with the field device network.

a. Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.
b. Alarm-Line Supervision:
1) Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal by monitoring for abnormal open, grounded, or shorted conditions using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of 10 percent or more for longer than 500 ms.
2) Transmit alarm-line-supervision alarm to the central station during the next interrogation cycle after the abnormal current condition.
c. Outputs: Managed by central-station software.
2. Auxiliary Equipment Power: A GFI service outlet inside the controller enclosure.

E. Entry-Control Controller:
1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers, keypads, biometric personnel identity-verification devices, door strikes, magnetic latches, gate and door operators, and exit push buttons.
a. Operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the controller and the field-device network.
b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:
1) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
2) Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control.
c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.
2. Inputs:
a. Data from entry-control devices; use this input to change modes between access and secure.
b. Database downloads and updates from the central station that include enrollment and privilege information.
3. Outputs:
a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
b. Grant or deny entry by sending control signals to portal-control devices and mask intrusion-alarm annunciation from sensors stimulated by authorized entries.
c. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the central station.
d. Door Prop Alarm: If a portal is held open for longer than 20 seconds, alarm sounds.
4. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.
5. Data Line Problems: For periods of loss of communication with the central station, or when data transmission is degraded and generating continuous checksum errors, the controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.
a. Store up to 1000 transactions during periods of communication loss between the controller and access-control devices for subsequent upload to the central station on restoration of communication.
6. Controller Power: NFPA 70, Class II power-supply transformer, with 12- or 24-V ac secondary, backup battery and charger.
a. Backup Battery: Sealed, lead-calcium battery; spill proof; with a full one-year warranty and a pro rata 8-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
b. Backup Battery: Valve-regulated, recombinant-sealed, lead-acid battery; spill proof. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.

c. Backup Power-Supply Capacity: 24 hours of standby supply. Submit battery and charger calculations.
d. Power Monitoring: Provide manual, dynamic battery-load test, initiated and monitored at the control center; with automatic disconnection of the controller when battery voltage drops below controller limits. Report by using local controller-mounted digital displays and by communicating status to central station. Indicate normal power on and battery charger on trickle charge. Indicate and report the following:
   1) Trouble Alarm: Normal power-off load assumed by battery.
   2) Trouble Alarm: Low battery.
   3) Alarm: Power off.

2.6 CARD READERS AND KEYPADS

A. Card-Reader Power: Powered from its associated controller, including its standby power source, and shall not dissipate more than 5 W.

B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the controller. Response time shall be 800 ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.

C. Enclosure: Suitable for surface, semi-flush, pedestal, or weatherproof mounting. Mounting types shall additionally be suitable for installation in the following locations:
1. Indoors, controlled environment.
2. Indoors, uncontrolled environment.
3. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.

D. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.

E. Proximity Readers:
1. Active-detection proximity card readers shall provide power to compatible credential cards through magnetic induction and shall receive and decode a unique identification code number transmitted from the credential card.
2. The card reader shall read proximity cards in a range from direct contact to at least 6 inches (150 mm) from the reader.

F. Keypads:
1. Entry-control keypads shall use a unique combination of alphanumeric and other symbols as an Identifier.
2. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII-code ordinal sequence.
3. Keypad shall provide staff functions such as (but not limited to):
   a. Arming system
   b. Disarming system
   c. Reset
   d. Silencing alarm
4. Communication protocol shall be compatible with the local processor.

G. Keypad Response Time:
1. The keypad shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 ms or less from the time the last alphanumeric symbol is entered until a response signal is generated.

H. Keypad Power:
1. The keypad shall be powered from the source as shown and shall not dissipate more than 150 W.

I. Keypad Mounting Method:
   1. Keypads shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.

J. Communication Protocol: Compatible with local processor.

2.7 PUSH-BUTTON SWITCHES

A. Push-Button Switches: Momentary-contact back-lighted push buttons with stainless-steel switch enclosures.

B. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.

C. Power: Push-button switches shall be powered from their associated controller, using dc control.

2.8 DOOR INTERFACE

A. Exit Device with Alarm: Operation of the exit device shall generate an alarm. Exit device and alarm contacts are specified in Division 8 Section "Door Hardware."

B. Exit Alarm: Operation of a monitored door shall generate an alarm. Exit devices and alarm contacts are specified in Section 087100 "Door Hardware."

C. Electric Door Strikes: Use end-of-line resistors to provide power-line supervision. Signal switches shall transmit data to controller to indicate when the bolt is not engaged and the strike mechanism is unlocked, and they shall report a forced entry. Power and signal shall be from the controller. Electric strikes are specified in Division 8 Section "Door Hardware."

D. Electromagnetic Locks: End-of-line resistors shall provide power-line supervision. Lock status sensing signal shall positively indicate door is secure. Power and signal shall be from the controller. Electromagnetic locks are specified in Division 8 Section "Door Hardware."

2.9 FIELD-PROCESSING SOFTWARE

A. Operating System:
   1. Local processors shall contain an operating system that controls and schedules that local processor's activities in real time.
   2. Local processor shall maintain a point database in its memory that includes parameters, constraints, and the latest value or status of all points connected to that local processor.
   3. Execution of local processor application programs shall utilize the data in memory resident files.
   4. Operating system shall include a real-time clock function that maintains the seconds, minutes, hours, date, and month, including day of the week.
   5. Local processor real-time clock shall be automatically synchronized with the central station at least once per day to plus or minus 10 seconds (the time synchronization shall be accomplished automatically, without operator action and without requiring system shutdown).

B. Startup Software:
   1. Causes automatic commencement of operation without human intervention, including startup of all connected I/O functions.
   2. Local processor restart program based on detection of power failure at the local processor shall be included in the local processor software.
   3. Initiates operation of self-test diagnostic routines.
   4. Upon failure of the local processor, if the database and application software are no longer resident, the local processor shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made.

5. If the database and application programs are resident, the local processor shall immediately resume operation.

C. Operating Mode:
1. Local processors shall control and monitor inputs and outputs as specified, independent of communications with the central station or designated workstations.
2. Alarms, status changes, and other data shall be transmitted to the central station or designated workstations when communications circuits are operable.
3. If communications are not available, each local processor shall function in a stand-alone mode and operational data, including the status and alarm data normally transmitted to the central station or designated workstations, shall be stored for later transmission to the central station or designated workstations.
4. Storage for the latest 4000 events shall be provided at local processors, as a minimum.
5. Local processors shall accept software downloaded from the central station.
6. Panel shall support flash ROM technology to accomplish firmware downloads from a central location.

D. Failure Mode: Upon failure for any reason, each local processor shall perform an orderly shutdown and force all local processor outputs to a predetermined (failure-mode) state, consistent with the failure modes shown and the associated control device.

E. Functions:
1. Monitoring of inputs.
2. Control of outputs.
3. Reporting of alarms automatically to the central station.
4. Reporting of sensor and output status to central station upon request.
5. Maintenance of real time, automatically updated by the central station at least once a day.
6. Communication with the central station.
7. Execution of local processor resident programs.
8. Diagnostics.
9. Download and upload data to and from the central station.

2.10 FIELD-PROCESSING HARDWARE

A. Alarm Annunciation Local Processor:
1. Respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.
2. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.
3. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.
4. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.
5. Local processor shall report line supervision alarms to the central station.
6. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 milliseconds.
7. Alarm condition shall be transmitted to the central computer during the next interrogation cycle.
8. Local processor outputs shall reflect the state of commands issued by the central station.
9. Outputs shall be a form C contact and shall include normally open and normally closed contacts.
10. Local processor shall have at least four command outputs.
11. Local processor shall be able to communicate with the central station via TCP/IP as a minimum.

B. Processor Power Supply:
1. Local processor and sensors shall be powered from an uninterruptible power source.

2. Uninterruptible power source shall provide eight hours of battery back-up power in the event of primary power failure and shall automatically fully recharge the batteries within 12 hours after primary power is restored.
3. If the facility is without an emergency generator, the uninterruptible power source shall provide 24 hours of battery backup power.
4. There shall be no equipment malfunctions or perturbations or loss of data during the switch from primary to battery power and vice versa.
5. Batteries shall be sealed, non-outgassing type.
6. Power supply shall be equipped with an indicator for ac input power and an indicator for dc output power.
7. Loss of primary power shall be reported to the central station as an alarm.

C. Entry-Control Local Processor:
1. Entry-control local processor shall respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.
2. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.
3. Entry-control local processor shall provide local entry-control functions including communicating with field devices such as card readers, keypads, biometric personnel identity-verification devices, door strikes, magnetic latches, gate and door operators, and exit push buttons.
4. Processor shall also accept data from entry-control field devices as well as database downloads and updates from the central station that include enrollment and privilege information.
5. Processor shall send indications of successful or failed attempts to use entry-control field devices and shall make comparisons of presented information with stored identification information.
6. Processor shall grant or deny entry by sending control signals to portal-control devices and mask intrusion-alarm annunciation from sensors stimulated by authorized entries.
7. Entry-control local processor shall use inputs from entry-control devices to change modes between access and secure.
8. Local processor shall maintain a date-time- and location-stamped record of each transaction and transmit transaction records to the central station.
9. Processor shall operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the local processor and the central station.
10. Processor shall store a minimum of 4000 transactions during periods of communication loss between the local processor and the central station for subsequent upload to the central station upon restoration of communication.
11. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.
12. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall also provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.
13. Local processor shall report line supervision alarms to the central station.
14. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 ms.
15. Alarm condition shall be transmitted to the central station during the next interrogation cycle.
16. Entry-control local processor shall include the necessary software drivers to communicate with entry-control field devices. Information generated by the entry-control field devices shall be accepted by the local processor and automatically processed to determine valid identification of the individual present at the portal.
17. Upon authentication of the credentials or information presented, the local processor shall automatically check privileges of the identified individual, allowing only those actions granted as privileges.
18. Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control. The local processor shall maintain a date-time- and location-stamped record of each transaction.
19. Transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.
20. Local processor outputs shall reflect the state of commands issued by the central station.
21. Outputs shall be a form C contact and shall include normally open and normally closed contacts.
22. Local processor shall have at least four addressable outputs.

23. The entry-control local processor shall also provide control outputs to portal-control devices.
24. Local processor shall be able to communicate with the central station via TCP/IP as a minimum.

2.11 CABLES

A. Plenum-Type, TIA 232-F Cables:
1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum-foil/polyester-tape shielded pairs with 100 percent shield coverage; plastic jacket.
2. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
3. NFPA 70, Type CMP.
4. Flame Resistance: NFPA 262 flame test.

B. Plenum-Type, TIA 485-A Cables:
1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

C. Multiconductor, Plenum-Type, Reader and Wiegand Keypad Cables:
1. Six conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

D. Paired, Plenum-Type, Lock Cables:
1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

E. Paired, Plenum-Type, Lock Cables:
1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

F. Paired, Plenum-Type, Input Cables:
1. One pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, aluminum-foil/polyester-tape shield (foil side out), with No. 22 AWG drain wire, 100 percent shield coverage, and plastic jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

G. Paired, Plenum-Type, AC Transformer Cables:
1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
2. NFPA 70, Type CMP.
3. Flame Resistance: NFPA 262 flame test.

H. LAN Cabling:
1. Comply with requirements in Division 27 Section "Structured Cabling Systems."
2. NFPA 262.

2.12 TRANSFORMERS

A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Comply with TIA/EIA 606-A, "Administration Standard for Commercial Telecommunications Infrastructure."

C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.
1. Record setup data for control station and workstations.
2. For each Location, record setup of controller features and access requirements.
3. Propose start and stop times for time zones and holidays, and match up access levels for doors.
4. Set up groups, facility codes, linking, and list inputs and outputs for each controller.
5. Assign action message names and compose messages.
6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
7. Prepare and install alarm graphic maps.
8. Develop user-defined fields.
9. Develop screen layout formats.
10. Propose setups for guard tours and key control.
11. Discuss badge layout options; design badges.
12. Complete system diagnostics and operation verification.
13. Prepare a specific plan for system testing, startup, and demonstration.
14. Develop acceptance test concept and, on approval, develop specifics of the test.
15. Develop cable and asset-management system details; input data from construction documents. Include system schematics and CAD Technical Drawings in electronic format.

D. In meetings with A/E and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

3.3 CABLING

A. Comply with NECA 1, "Good Workmanship in Electrical Construction."

B. Install cables and wiring according to requirements in Division 26 Section "Wires, Cables, and Connectors."

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental airspaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

E. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and fiber-optic rating of components, and that ensure Category 6 and fiber-optic performance of completed and linked signal paths, end to end.

F. Boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

G. Install end-of-line resistors at the field device location and not at the controller or panel location.

3.4 CABLE APPLICATION

A. Comply with TIA 569-B, "Commercial Building Standard for Telecommunications Pathways and Spaces."

B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.

C. TIA 232-F Cabling: Install at a maximum distance of 50 ft.

D. TIA 485-A Cabling: Install at a maximum distance of 4000 ft.

E. Card Readers and Keypads:
1. Install number of conductor pairs recommended by manufacturer for the functions specified.
2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from controller to the reader is 250 ft, and install No. 20 AWG wire if maximum distance is 500 ft.
3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the controller.
4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.

F. Install minimum No. 16 AWG cable from controller to electrically powered locks. Do not exceed 250 ft.

G. Install minimum No. 18 AWG ac power wire from transformer to controller, with a maximum distance of 25 ft.

3.5 GROUNDING

A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Bond shields and drain conductors to ground at only one point in each circuit.

E. Signal Ground:

1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
2. Bus: Mount on wall of main equipment room with standoff insulators.
3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.6 INSTALLATION

A. Push Buttons: Where multiple push buttons are housed within a single switch enclosure, they shall be stacked vertically with each push-button switch labeled with 1/4-inch- (6.4-mm-) high text and symbols as required. Push-button switches shall be connected to the controller associated with the portal to which they are applied, and shall operate the appropriate electric strike, electric bolt, or other facility release device.

B. Install card readers, keypads, push buttons, and biometric readers.

3.7 IDENTIFICATION

A. In addition to requirements in this article, comply with applicable requirements in Division 26 Section "Identification for Electrical Systems" and with TIA/EIA 606-A.

B. Using software specified in "Cable and Asset Management Software" Article, develop cable administration drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.

C. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

D. At completion, cable and asset management software shall reflect as-built conditions.

3.8 SYSTEM SOFTWARE AND HARDWARE

A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA 568-B.1, "Commercial Building Telecommunications Cabling Standards - Part 1: General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA 568-B.1.

2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
4. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Devices and circuits will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 STARTUP SERVICE

A. Engage a factory-authorized service representative to supervise and assist with startup service.
1. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
2. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

3.11 PROTECTION

A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured with an activated burglar alarm and access-control system reporting to a central station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain security access system.

B. Develop separate training modules for the following:
1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
3. Security personnel.
4. Hardware maintenance personnel.
5. Corporate management.

END OF SECTION 28 13 00

SECTION 28 16 00

INTRUSION DETECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Intrusion detection with communication links to perform monitoring, alarm, and control functions.

1.2 DEFINITIONS

A. CCTV: Closed-circuit television.

B. PIR: Passive infrared.

C. RFI: Radio-frequency interference.

D. UPS: Uninterruptible power supply.

E. Control Unit: System component that monitors inputs and controls outputs through various circuits.

F. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected zones and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.

G. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.

H. Protected Zone: A protected premises or an area within a protected premises that is provided with means to prevent an unwanted event.

I. Standard Intruder: A person who weighs 100 lb or less and whose height is 60 inches or less; dressed in a long-sleeved shirt, slacks, and shoes.

J. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

K. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.

L. Zone. A defined area within a protected premises. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

1.3 ACTION SUBMITTALS

A. Product Data: Components for sensing, detecting, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify control interface devices and media to be used. Describe characteristics of network and other data communication lines.

    a. Indicate methods used to achieve systems integration.
    b. Indicate control, signal, and data communication paths and identify PLCs, networks, control interface devices, and media to be used.
    c. Describe characteristics of network and other data communication lines.
    d. Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.

2. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection. Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.
3. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building.
4. Master Control-Unit Console Layout: Show required artwork and device identification.
5. Device Address List: Coordinate with final system programming.
6. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
7. Details of surge-protection devices and their installation.
8. Sensor detection patterns and adjustment ranges.

C. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Data for each type of product, including features and operating sequences, both automatic and manual.
2. Master control-unit hardware and software data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.
2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.

E. FM Global Compliance: FM-Approved and -labeled intrusion detection devices and equipment.

F. Comply with NFPA 70.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products by the following:
1. Lenel
2. Interlogix
3. Or Owner approved equal

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Description: Hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.

B. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.

1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.
2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.
3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or control unit.

C. System Control: Master control unit shall directly monitor intrusion detection units and connecting wiring.

D. System Control: Master control unit shall directly monitor intrusion detection devices, and connecting wiring in a multiplexed distributed control system or as part of a network.

E. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.

F. Operator Commands:

1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.

G. Timed Control at Master Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.

H. Automatic Control of Related Systems: Alarm or supervisory signals from certain intrusion detection devices control the following functions in related systems:

1. Switch selected lights.
2. Shift elevator control to a different mode.
3. Switch signal to selected monitor from CCTV camera in vicinity of sensor signaling an alarm.

I. Printed Record of Events: Print a record of alarm, supervisory, and trouble events on system printer. Sort and report by protected zone, device, and function. When master control unit receives a signal, print a report of alarm, supervisory, or trouble condition. Report type of signal (alarm, supervisory, or trouble), protected zone description, date, and time of occurrence. Differentiate alarm signals from other indications. When system is reset, report reset event with the same information concerning device, location, date, and time. Commands shall initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.

J. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.

K. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time

between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.

L. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

M. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

2.3 SYSTEM COMPONENT REQUIREMENTS

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors.
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.

B. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.

C. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.

D. Tamper Protection: Tamper switches on detection devices, control units, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Master control-unit alarm display shall identify tamper alarms and indicate locations.

E. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to master control unit.

F. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to master control unit as an alarm signal.

G. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to master control unit.

H. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at master control unit for calibration, sensitivity, and alarm condition.

2.4 ENCLOSURES

A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.

B. Interior Electronics: NEMA 250, Type 12.

C. Exterior Electronics: NEMA 250, Type 4X

D. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

2.5 SECURE AND ACCESS DEVICES

A. Keypad and Display Module: Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.

2.6 DOOR AND WINDOW SWITCHES

A. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.

B. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.

C. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounted magnet and floor-mounted switch unit.

D. Remote Test: Simulate movement of actuating magnet from master control unit.

2.7 PIR SENSORS

A. Listed and labeled by a qualified testing agency for compliance with SIA PIR-01.

B. Description: Sensors detect intrusion by monitoring infrared wavelengths emitted from a human body within their protected zone and by being insensitive to general thermal variations.

1. Wall-Mounted Unit Maximum Detection Range: 125 percent of indicated distance for individual units and not less than 50 feet.
2. Ceiling-Mounted Unit Spot-Detection Pattern: Full 360-degree conical.
3. Ceiling-Mounted Unit Pattern Size: 84-inch (2135-mm) diameter at floor level for units mounted 96 inches (2440 mm) above floor; 18-foot (5.5-m) diameter at floor level for units mounted 25 feet (7.6 m) above floor.

C. Device Performance:

1. Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F (1 deg C) or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s) across two adjacent segments of detector's field of view.
2. Test Indicator: LED test indicator that is not visible during normal operation. When visible, indicator shall light when sensor detects an intruder. Locate test enabling switch under sensor housing cover.
3. Remote Test: When initiated by master control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

2.8 PIEZOELECTRIC-TYPE, GLASS-BREAK SENSORS

A. Listed and labeled by a qualified testing agency for compliance with SIA GB-01.

B. Device Performance: Detect unique, high-frequency vibrations caused by breaking glass.

1. Sensor Element: Piezoelectric crystals in a housing designed to mount directly to glass surface with adhesive provided by element manufacturer. Circular detection pattern, with at least a 60-inch (1525-mm) radius on a continuous glass pane. Sensor element shall not be larger than 4 sq. in. (25.80 sq. cm).
2. Hookup Cable: Factory installed, not less than 72 inches (1830 mm).

3. Activation Indicator: LED on sensor housing that lights when responding to vibrations, remaining on until manually reset at sensor control unit.
4. Control Unit: Integral with sensor housing or in a separate assembly, locally adjustable by control under housing cover.
5. Glass-Break Simulator: A device to induce frequencies into protected glass pane that simulate breaking glass without causing damage to glass.

2.9 DURESS-ALARM SWITCHES

A. Description: A switch with a shroud over the activating lever that allows an individual to covertly send a duress signal to master control unit, with no visible or audible indication when activated. Switch shall lock in activated position until reset with a key.

1. Minimum Switch Rating: 50,000 operations.
2. Foot Rail: Foot activated, floor mounting.
3. Push Button: Finger activated, suitable for mounting on horizontal or vertical surface.

2.10 MASTER CONTROL UNIT

A. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.

1. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
2. Include a real-time clock for time annotation of events on the event recorder and printer.
3. Addressable initiation devices that communicate device identity and status.
4. Control circuits for operation of mechanical equipment in response to an alarm.

B. Construction: Freestanding equipment rack, modular, with separate and independent alarm and supervisory system modules. Alarm-initiating protected zone boards shall be plug-in cards. Arrangements that require removal of field wiring for module replacement are unacceptable.

C. Console Controls and Displays:

D. Power Supply Circuits: Master control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.

E. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. If more than a single cabinet is required to form a complete control unit, provide exactly matching modular enclosures. Accommodate all components and allow ample gutter space for field wiring. Identify each enclosure by an engraved, laminated, phenolic-resin nameplate. Lettering on enclosure nameplate shall not be less than 1 inch high. Identify, with permanent labels, individual components and modules within cabinets.

F. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over a standard voice grade telephone leased line. Comply with UL 1635.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.

D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Re-inspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.

E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SYSTEM INTEGRATION

A. Integrate intrusion detection system with the following systems and equipment:

1. Electronic door hardware.
2. Network lighting controls.
3. Intercommunications and program systems.
4. Access control.
5. Fire-alarm system.
6. Video surveillance.

3.3 SYSTEM INSTALLATION

A. Comply with UL 681 and NFPA 731.

B. Equipment Mounting: Install master control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.

C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches the finished floor.

D. Connecting to Existing Equipment: Verify that existing perimeter security system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the Supervising Station.

E. Security Fasteners: Where accessible to inmates, install intrusion detection components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent

materials except that a maximum of two different sets of tools shall be required to operate security fasteners for Project.

3.4 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceways according to Division 26 Section "Raceways and Fittings." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Wires and Cables:

1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.
2. 120-V Power Wiring: Install according to Division 26 Section “Wire, Cables, and Connectors.”
3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable, according to Division 27 “Structured Cabling Systems”.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

G. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with identification requirements in Section 260553 "Identification for Electrical Systems."

B. Install instructions frame in a location visible from master control unit.

3.6 GROUNDING

A. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.

B. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

C. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 3-ohm ground. Measure, record, and report ground resistance.

D. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

E. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."

1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."

F. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."

G. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

END OF SECTION 28 16 00

SECTION 28 20 00

VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a video surveillance system consisting of cameras, digital video recorder, data transmission wiring, and a control station with its associated equipment.

1.2 DEFINITIONS

A. AGC: Automatic gain control.

B. BNC: Bayonet Neill-Concelman - type of connector.

C. B/W: Black and white.

D. CCD: Charge-coupled device.

E. FTP: File transfer protocol.

F. IP: Internet protocol.

G. LAN: Local area network.

H. MPEG: Moving picture experts group.

I. NTSC: National Television System Committee.

J. PC: Personal computer.

K. PTZ: Pan-tilt-zoom.

L. RAID: Redundant array of independent disks.

M. TCP: Transmission control protocol - connects hosts on the Internet.

N. UPS: Uninterruptible power supply.

O. WAN: Wide area network.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
4. Wiring Diagrams: For power, signal, and control wiring.

C. Design Data: Include an equipment list consisting of every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for cameras, camera-supporting equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

C. Product Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NECA 1.

C. Comply with NFPA 70.

D. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

2.2 IP CAMERAS

A. Fixed Camera
1. The camera shall be of a dome type suitable for internal installation. The camera shall be ivory in appearance.
2. The network camera shall feature up to 3 Mega Pixel resolution in a 16:9 format. 4:3 format shall also be available in smaller resolutions.
3. The camera should be capable of capturing and transmitting an image size of 1920 x 1080 at 60 images per second.
4. Basis of Design: Hanwa SND 7084.

B. PTZ Camera
1. A 2 MP IP video camera, with multi-streaming (H.264 and MJPEG) capability and 23x zoom ration in IP66/IK10 rated dome housing.
2. Video Compression and Transmission – The 2 MP camera shall have the following properties relating to the video signals it produces.
    a. H.264 and MJPEG compression, each derived from a dedicated encoder and capable of being streamed independently and simultaneously
        1) H.264 – frame rates up to 30 fps
        2) MJPEG – frame rates up to 30 fps
3. The 2 MP camera shall be able to configure up to 10 independent video stream profiles with differing encoding, quality, frame rate, resolution, and bit rate settings.
4. Resolution selections
    a. 1080p (1920 x 1080) Full HD, 720p (1280 x 720) HD
    b. 1280 x 1024, 1280 x 960, 1024 x 768, 800 x 600, 800 x 450, 720 x 576, 640 x 480, 640 x 360,

        320 x 240, 320 x 180
5. Simultaneous unicast access by up to 10 users
6. Multicast or unicast capable
7. Dynamic DNS (DDNS) support
8. 1V peak-peak composite video output signal at camera for setup and diagnostics
9. Camera – The 2 MP camera device shall have the following physical and performance properties:
    a. Dustproof, waterproof, and IP66 rated.
    b. True day/night operation with removable IR cut filter
    c. Low light level operation to 0.15 lux (color) and 0.015 lux (black and white)
    d. 100 dB multi-exposure Wide Dynamic Range, providing a wide range between dark and light areas visible at the same time
    e. 2D and 3D digital noise reduction
    f. Digital zoom
    g. 32 privacy masking regions utilizing a 4 point polygon
    h. Digital image stabilization
10. Intelligence and Analytics – The 2 MP camera shall have a suite of integral intelligent operations and analytic functions to include:

a. Motion detection with four definable detection areas, minimum / maximum object size definition and a learning algorithm that ignores false alarms such as trees and waves on water.
b. Detection of logical events of specified conditions from the camera's video input
    1) line crossing (passing)
    2) appear/disappear
    3) audio detection
    4) camera tamper (scene change)
    5) enter/exit a predefined zone
c. Face detection used to create an event whenever there is a face or multiple faces in the image, up to detection of 32 faces simultaneously
d. Audio detection above a specified threshold
e. Smart Codec operation in which the camera adaptively alters the video compression for a region of interest or a detected face to improve the quality of video in the area specified.
f. definable up to 5 regions of interest

11. Interoperability – The 2 MP camera shall be ONVIF Profile S compliant.
12. The 2 MP camera shall possess the following further characteristics:
    a. Built-in web server, accessed via standard browsers including Internet Explorer, Firefox, Chrome & Safari
    b. Micro SD/SDHC/SDXC memory card and NAS recording options, with configurable pre-alarm and post-alarm recording intervals
    c. Bi-directional audio
13. Alarms and notifications
    a. 4 physical alarm input and 2 output
    b. alarm notification triggers:
        1) video analytics
        2) motion detection
        3) tampering
        4) audio detection
        5) face detection
        6) network disconnection
        7) physical alarm input
        8) event from embedded third party application
    c. available notification means upon trigger:
        1) file upload via FTP and e-mail
        2) notification via e-mail
        3) record to local storage (SD card)
        4) record to network storage
        5) external output
14. POE capable
15. Basis of Design: Hanwa SNP-L6233H

2.3 MULTI-VIEW CAMERA

A. The camera shall provide 360-degree field of view and produce video in quad view mode. It shall also provide digital PTZ along with automated video analytics to allow users to efficiently monitor large visual fields with capability to focus on certain areas when suspicious activity is observed.

B. Video Compression and Transmission – The multi-directional camera shall have the following properties relating to the video signals it produces.
1. H.265, H.264 and MJPEG compression, each derived from a dedicated encoder and capable of being streamed independently and simultaneously
    a. H.265 and H.264 – Maximum of 30 fps at all resolutions
    b. MJPEG – Maximum of 30 fps
2. The multi-directional camera shall be able to configure up to 10 independent video stream profiles with differing encoding, quality, frame rate, resolution, bit rate, and other video settings.
3. The multi-directional camera shall have four lenses and each lens shall provide the following resolutions.

a. 1920 x 1080, 1280 x 1024, 1280 x 960, 1280 x 720, 1024 x 768, 800 x 600, 800 x 450, 720 x 576, 640 x 480, 640 x 360, 320 x 240
4. Simultaneous unicast access by up to 20 users
5. Multicast or unicast capable
6. Dynamic DNS (DDNS) support
7. The multi-directional camera shall provide smart codec (WiseStream, Dynamic GOV, and Dynamic fps) to efficiently manage bit rate of the video stream and reduce storage while producing video quality that is visually equal to the one without smart codec.
8. Viewing composition: Quad view

C. Camera – The multi-directional camera device shall have the following physical and performance properties:
1. IK10 rated for protection against impacts
2. IP66 for protection against dust and water
3. Auto day/night operation with removable IR cut filter
a. Low light level operation to 0.07 lux (color) and 0.007 lux (black and white)
4. 2D and 3D digital noise reduction
5. 32 privacy masking regions utilizing polygons
6. The multi-directional camera shall be able to capture high contrast scenes with 150 dB multi-exposure wide dynamic range.
7. One touch (Simple) or manual focus controllable remotely via network. The camera shall have motorized varifocal lens.
8. Advanced digital image stabilization with built in gyro sensor. The camera shall be able to measure movements in three axes and accurately enhance images from distortions caused by instability.

D. Intelligence and Analytics – The multi-directional camera shall have a suite of integral intelligent operations and analytic functions to include:
1. Motion detection with eight definable detection areas, minimum/maximum object size definition and a learning algorithm that ignores false alarms such as trees and waves on water. The camera shall also be able to send meta-data to NVR or VMS to allow users to search for motion events and generate video summary.
2. Detection of logical events of specified conditions from the camera's video input
a. camera tamper (scene change)
b. loitering
c. directional detection
d. defocus detection
e. fog detection
f. virtual line
g. enter/exit
h. appear/disappear

E. Interoperability – The multi-directional camera shall be ONVIF Profile S compliant.

F. The multi-directional camera shall possess the following further characteristics:
1. Built-in web server, accessed via standard browsers including Internet Explorer, Firefox, Chrome & Safari
2. Micro SD/SDHC/SDXC memory card options, with configurable pre-alarm and post-alarm recording intervals
3. Alarms and notifications
a. alarm notification triggers:
1) alarm input
2) motion detection
3) video analytics
4) network disconnect
b. available notification means upon trigger:
1) file upload via FTP and e-mail
2) notification via e-mail
3) record to local storage (SD/SDHC/SDXC card)
4) external output
5) Pixel Counter available in the plug-in web viewer

4. Basis of Design: Hanwa PNM-9080VQ

2.4 CAMERA-SUPPORTING EQUIPMENT

A. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.

B. Pan-and-Tilt Units: Motorized units arranged to provide remote-controlled aiming of cameras with smooth and silent operation and equipped with matching mounting brackets.

1. Panning Rotation: 0 to 355 degrees, with adjustable stops.
2. Tilt Movement: 90 degrees, plus or minus 5 degrees, with adjustable stops.
3. Speed: 12 degrees per second in both horizontal and vertical planes.
4. Wiring: Factory prewired for camera and zoom lens functions and pan-and-tilt power and control.
5. Built-in encoders or potentiometers for position feedback, and thermostat-controlled heater.
6. Pan-and-tilt unit shall be available with preset positioning capability to recall the position of a specific scene.

C. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.

D. Outdoor Protective Housings for Cameras: Aluminum enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.

1. Mechanical (Vandal) Protection: IK10
2. Ingress Protection: IP66
3. Alignment Provisions: Camera mounting shall provide for field aiming of camera and permit removal and reinstallation of camera lens without disturbing camera alignment.
4. Built-in, thermostat-activated heater and blower units. Units shall be automatically controlled so the environmental limits of the camera equipment are not exceeded.
5. Sun shield shall not interfere with normal airflow around the housing.
6. Mounting bracket and hardware for wall or ceiling mounting of the housing. Bracket shall be of same material as the housing; mounting hardware shall be stainless steel.
7. Finish: Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the environment.

2.5 NETWORK VIDEO RECORDERS

A. Description: Digital Network Video Recorder
1. Internal minimum 240TB Enterprise Class hard disk drive for video storage
2. Solid state hard disk drive for Windows operating system
3. Supports up to 128 IP Cameras
4. Continuous recording up to 1,200Mbps of video
5. Simultaneous connection for up to 500 clients
6. Minimum dual 10Gbps network interfaces
7. Remote monitoring with email/text notification capability

B. Basis of Design: ExacqVision Z-series

2.6 VIDEO MANAGEMENT SOFTWARE (VMS)

A. Description:
1. The Video Management System (VMS) shall be a software package for comprehensive management of live and recorded video, and associated audio and data.

2. The VMS shall possess the following general characteristics:
   a. provide effective monitoring of video from IP cameras and encoding devices, two-way audio and data in real time over local and wide area networks
   b. interactive and multi-level mapping
   c. data integration from retail and access control systems
   d. single-screen administration across multiple servers and systems, including:
      1) global configuration and monitoring of camera, encoder, and storage settings across the enterprise
      2) administration of all users on multiple servers
      3) e-mail and text (SMS) notifications
3. automatic identification and IP address assignment of compatible IP cameras and encoders with status display
   a. The option to enable an embedded DHCP server to assign camera addresses via DHCP.
4. open architecture supporting IP cameras and encoders and access control systems from multiple manufacturers
5. available client software to allow remote access to live and recorded video, including access from mobile devices
   a. support simultaneous access to video from multiple servers
6. virtual matrix functionality
7. provisioned as a service without requiring any application to be running in order to operate
8. 2-way audio support between server, client, and camera

B. Basis of Design: ExacqVision Enterprise VMS

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.

B. Examine roughing-in for LAN, WAN, and IP network before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING

A. Comply with requirements in Section 270528 "Pathways for Communications Systems."

B. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

C. For communication wiring, comply with the following:
   1. Section 271513 "Communications Copper Horizontal Cabling."

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Install cameras level and plumb.

B. Install cameras with 84-inch- minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.

C. Set pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms and adjust.

D. Identify system components, wiring, cabling, and terminals according to Section 270553 "Identification for Communications Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:

    a. Prepare equipment list described in "Informational Submittals" Article.
    b. Verify operation of auto-iris lenses.
    c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
    d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
    e. Set and name all preset positions; consult Owner's personnel.
    f. Set sensitivity of motion detection.
    g. Connect and verify responses to alarms.
    h. Verify operation of control-station equipment.

3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

E. Video surveillance system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
3. Adjust all preset positions; consult Owner's personnel.
4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
5. Provide a written report of adjustments and recommendations.

3.6 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

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SECTION 28 31 11

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Air-sampling smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Device guards.
8. Magnetic door holders.
9. Remote annunciator.
10. Graphic annunciator.
11. Addressable interface device.
12. Digital alarm communicator transmitter.
13. Radio alarm transmitter.
14. Network communications.

1.2 DEFINITIONS

A. FACP: Fire Alarm Control Panel.

B. NICET: National Institute for Certification in Engineering Technologies.

C. PC: Personal computer.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.

8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors according to manufacturer's written recommendations.
    d. Show air-sampling detector pipe routing.

13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device.

C. General Submittal Requirements:

1. Shop Drawings shall be prepared by persons with the following qualifications:
    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level III minimum.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

    a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
    b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
    d. Riser diagram.
    e. Device addresses.
    f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
    g. Record copy of site-specific software.

h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

i. Manufacturer's required maintenance related to system warranty requirements.
j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 SPARE PARTS

A. ADDITIONAL INSTALLED DEVICES

1. The Contractor shall include in his bid for the provision and installation of the following additional devices:

a.	Smoke detectors	4
b.	Heat detectors	2
c.	Duct smoke detectors	2
d.	Manual fire alarm box	2
e.	Speaker/Strobe device	4
f.	Strobe device	2
g.	Addressable interface module	4

2. In addition to the above listed devices, the contractor shall include 50'-0" length of conduit and wire for each device, and shall assume that the devices will be installed at the completion of the project as directed by the A/E or Owner. If not all devices are used, the remaining devices shall be turned over to the Owner and any unused amount of labor, conduit and wire shall be credited to the Owner in a deduct change order.

1.7 QUALITY ASSURANCE

A. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: TWO years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Provide system manufacturer's certification that all components provided have been tested as, and will operate as a system.

B. Noncoded, UL-listed addressable system, with multiplexed signal transmission with voice enabled speaker and strobe notification.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire Alarm Signal:

1. Fire Alarm signal initiation shall be by one or more of the following devices and/or systems:
   a. Manual stations.
   b. Heat detectors.
   c. Smoke detectors.
   d. Duct smoke detectors.
   e. Carbon monoxide detectors.
   f. Combustible gas detectors.
   g. Automatic sprinkler system water flow.
   h. Fire-extinguishing system operation.

2. Fire-alarm signal shall initiate the following actions:
   a. Continuously operate alarm notification appliances, including voice evacuation notices.
   b. Identify alarm and specific initiating device at fire-alarm control units and remote annunciators.
   c. Identify alarm and specific initiating device at connected network control panels and/or off-premises network control panels.
   d. Transmit an alarm signal to the remote alarm receiving station.
   e. Unlock electric door locks in designated egress paths.
   f. Release fire and smoke doors held open by magnetic door holders.
   g. Activate voice/alarm communication system.
   h. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
   i. Close smoke dampers in air ducts of designated air-conditioning duct systems.
   j. Recall elevators to primary or alternate recall floors.
   k. Activate elevator power shunt trip.
   l. Record events in the system memory.
   m. Indicate device in alarm on the graphic annunciator.

B. Supervisory Signal:

1. Supervisory signal initiation shall be by one or more of the following devices and actions:
   a. Valve supervisory switch.
   b. Alert and Action signals of air-sampling detector system.
   c. Elevator shunt-trip supervision.
   d. User disabling of zones or individual devices.
   e. Loss of communication with any panel on the network.

2. System Supervisory signal shall initiate the following actions:
   a. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
   b. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
   c. Transmit system status to building management system.
   d. Display system status on graphic annunciator.

C. System Trouble Signal:

1. System trouble signal initiation shall be by one or more of the following devices and actions:
   a. Open circuits, shorts, and grounds in designated circuits.
   b. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
   c. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
   d. Loss of primary power at fire-alarm control unit.
   e. Ground or a single break in internal circuits of fire-alarm control unit.
   f. Abnormal ac voltage at fire-alarm control unit.
   g. Break in standby battery circuitry.
   h. Failure of battery charging.
   i. Abnormal position of any switch at fire-alarm control unit or annunciator.
   j. Voice signal amplifier failure.
   k. Hose cabinet door open.

2. System trouble signal shall initiate the following actions:
   a. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
   b. Transmit system status to building management system.
   c. Display system status on graphic annunciator.

2.3 FIRE-ALARM CONTROL UNIT

A. Subject to compliance with requirements, provide products by the following manufacturer;

1. Notifier (no exception)

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

   a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder.
   c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
   d. The FACP shall be listed for connection to a central-station signaling system service.
   e. The FACP shall be listed for use with supervisory signals from other essential building systems.
   f. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.

3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
3. Shall indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Contractor shall verify quantity of each circuit type required with his approved equipment vendor prior to bidding. Fire alarm riser drawings that may be shown on the drawings are intended to be schematic in nature and may not depict all circuits where multiple circuits are required.
2. Pathway Class Designations: NFPA 72, Class B.
3. Pathway Survivability: Level 0.
4. Install no more than 99 addressable devices on each signaling-line circuit.
5. Serial Interfaces:

a. One dedicated RS 485 port for central-station remote station operation using point ID DACT.
b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One USB RS 232 port for PC configuration.
d. One RS 232 port for voice evacuation interface.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Sound general alarm if the alarm is verified.
4. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Elevator Recall:

1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:

a. Elevator lobby detectors except the lobby detector on the designated floor.
b. Smoke detector in elevator machine room.
c. Smoke detectors in elevator hoistway.

2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.

a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

H. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

I. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.

J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

K. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators.

1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.

    a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
    b. Programmable tone and message sequence selection.
    c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

L. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters, and digital alarm radio transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

M. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed, valve-regulated, recombinant lead acid, Sealed lead calcium.

N. Surge Suppression: Provide surge suppression devices at each 120V circuit serving fire alarm equipment. Refer to specification section 26 43 13 – Surge Protection for Low Voltage Electrical Power for requirements.

O. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

P. Manual Fire-Alarm Boxes

1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible

indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

a. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
b. Station Reset: Key- or wrench-operated switch.
c. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.
d. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

Q. Notification Appliances

1. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
   a. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
2. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
   a. Rated Light Output minimum:
      1) 15 cd. in corridors and transition spaces, unless otherwise noted.
      2) 30 cd. in other spaces, unless otherwise noted.
   b. Mounting: Wall mounted unless otherwise indicated.
   c. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   d. Flashing shall be in a temporal pattern, synchronized with other units.
   e. Strobe Leads: Factory connected to screw terminals.
   f. Mounting Faceplate: Factory finished, WHITE.
3. Voice/Tone Notification Appliances:
   a. Comply with UL 1480.
   b. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
   c. High-Range Units: Rated 2 to 15 W.
   d. Low-Range Units: Rated 1 to 2 W.
   e. Mounting: Flush semi-recessed or surface mounted and bidirectional.
   f. Matching Transformers: Tap range matched to acoustical environment of speaker location.
   g. Mounting Faceplate: Factory finished, WHITE.

R. Addressable Interface Device

1. General:
   a. Include address-setting means on the module.
   b. Store an internal identifying code for control panel use to identify the module type.
   c. Listed for controlling HVAC fan motor controllers.
2. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
3. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown .
   a. Allow the control panel to switch the relay contacts on command.
   b. Have a minimum of two normally open and two normally closed contacts available for field wiring.

4. Control Module:
   a. Operate notification devices.

b. Operate solenoids for use in sprinkler service.

S. System Smoke Detectors

1. General Requirements for System Smoke Detectors:
   a. Comply with UL 268; operating at 24-V dc, nominal.
   b. Detectors shall be two-wire type.
   c. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
   d. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   e. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
      1) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
      2) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
      3) Multiple levels of detection sensitivity for each sensor.
      4) Sensitivity levels based on time of day.

2. Photoelectric Smoke Detectors:
   a. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   b. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
      1) Primary status.
      2) Device type.
      3) Present average value.
      4) Present sensitivity selected.
      5) Sensor range (normal, dirty, etc.).

3. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
   a. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   b. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
      1) Primary status.
      2) Device type.
      3) Present average value.
      4) Present sensitivity selected.
      5) Sensor range (normal, dirty, etc.).
   c. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
   d. Each sensor shall have multiple levels of detection sensitivity.
   e. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
   f. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

T. Heat Detectors

1. General Requirements for Heat Detectors: Comply with UL 521.
   a. Temperature sensors shall test for and communicate the sensitivity range of the device.
2. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
   a. Mounting: Adapter plate for outlet box mounting Twist-lock base interchangeable with smoke-detector bases.
   b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

U. Magnetic Door Holders

1. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
   a. Electromagnets: Require no more than 3 W to develop 25-lbfholding force.
   b. Wall-Mounted Units: Flush mounted unless otherwise indicated.
   c. Rating: 24-V ac or dc. Rating: 120-V ac.

2. Material and Finish: Match door hardware.

V. Graphic Annunciator

1. Graphic Annunciator Workstation: PC-based, with fire-alarm annunciator software with historical logging, report generation, and a graphic interface showing all alarm points in the system. PC with operating system software, minimum 500GB hard drive, 19" digital display monitor, with wireless keyboard and mouse.

W. Remote Annunciator

1. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
   a. Mounting: Flush cabinet, NEMA 250, Type 1.

2. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.4 IP/GSM DIGITAL ALARM COMMUNICATOR

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 63 and UL 864.

B. Basic Performance:
1. The Communicator connect directly to the primary and secondary analog UL Listed Fire Alarm Control Panel telephone ports.
2. The Communicator will communicate to GSM networks in the area including 2G, 3G and 4G. The multi-GSM platform technology automatically detects and chooses the best network in the area based on signal strength and immediately self adjusts for operation.
3. Supports both dynamic (DHCP) or Public and Private Static IP addressing.
4. Communicates over any type of customer-provided Ethernet 10/100 Base network connection (LAN or WAN), DSL modem or cable modem.
5. Data transmits over standard contact-ID protocol is secured with the industry's advanced encryption standard (AES 256 bit).
6. Dual path communications: Uses Internet or GSM as primary.
7. User programmable: 7720P Programming Tool.
8. Diagnostic LEDs: Signal strength and status indications.
9. IP and GSM tested every day.
10. All circuits shall be power-limited, per UL864 requirements

C. When a fire alarm condition (Alarm, Supervisory or Trouble) is detected, the Fire Alarm Control Panel goes off-hook to dial the central station. The Dialer Capture Module detects the off-hook condition and provides the fire panel with a dial tone. When the fire panel detects the dial tone, it begins dialing the central station. The Dialer Capture Module considers the three second period after dialing as the number dialing has been completed. After the dialing is completed, the Dialer Capture Module returns a handshake to the fire panel. The fire panel then sends the contact ID reports to the Dialer Capture Module, which in turn sends a kiss-off after the report is successfully received from the fire panel. The Dialer Capture Module sends the contact ID reports to the GSM communications module. When all the reports are sent, the fire panel goes

on-hook. The GSM communications module then transmits the messages to the central station (either over the internet or the GSM network)..

D. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

E. Digital data transmission shall include the following:
1. Independent Zone (Alarm, trouble, non-alarm, supervisory)
2. Independent Addressable Device Status
3. AC (Mains) Power Loss
4. Low Battery and Earth Fault
5. System Off Normal
6. 24 Hour Test Signal
7. Abnormal Test Signal (per UL requirements)

F. Secondary Power: Integral rechargeable battery and automatic charger.

G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

H. Basis of Design: Notifier IPGSM-4G Communicator

2.5 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by device manufacturer.
2. Finish: Paint of color to match the protected device.

2.6 FIRE ALARM CABLE

A. Furnish only wire recommended by the fire alarm system manufacturer. Coordinate closely with equipment vendor for quantity, type, and size of fire alarm cables required.

B. SLC Circuit Cable for Addressable Initiation Devices: Power-limited (FPLP) solid or stranded (7 strand minimum) copper, 75 Degrees C insulation, #18 AWG twisted, shielded or unshielded, color-coded vinyl insulation, PVC jacket.

C. NAC Circuit Cable for Notification Devices: Power-limited (FPLP), solid or stranded (7 strand minimum) copper, 75 Degrees C insulation, #14 AWG twisted, shielded or unshielded, color-coded vinyl insulation, PVC jacket.

D. All wiring shall be color coded and labeled at each end.

E. Splicing by way of wire nuts is prohibited. Terminal junction boxes shall be used for wire taps.

F. All fire alarm wiring shall be plenum rated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

3.3 PATHWAYS

A. Fire alarm cable above ceilings and in non-accessible locations may be routed exposed, where supported by j-hooks or other approved method.

1. Exposed fire alarm cable located less than 96 inches above the floor shall be installed in raceway.

B. All fire alarm cable shall be installed in raceway.

C. Exposed fire alarm raceways shall be painted red enamel.

3.4 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Smoke dampers in air ducts of designated HVAC duct systems.
2. Magnetically held-open doors.
3. Electronically locked doors and access gates.
4. Alarm-initiating connection to elevator recall system and components.
5. Supervisory connections at valve supervisory switches.
6. Supervisory connections at elevator shunt-trip breaker.
7. Data communication circuits for connection to building management system.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by the Authority Having Jurisdiction and Owner.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include TWELVE months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for TWO years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within TWO years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

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SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing obstructions, trees, shrubs, and other vegetation, including grinding stumps and removing roots and debris.
4. Stripping and stockpiling topsoil surplus topsoil for lawn areas.
5. Providing temporary erosion and sedimentation control measures.

1.02 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction as indicated on Drawings and according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection.".

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Prior to any work within the tree protection zone, conduct a project conference at the site.

B. Prior to removal of any understory or invasive plant material, coordinate with the owner's representative to schedule a walk through to identify and tag all trees and plants to remain and be protected.

1.04 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and removed from Project site.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Herbicides

1.06 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project

D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

E. Burning: Burning tree, shrub, and other vegetation waste is **not** permitted according to burning requirements and permitting of authorities having jurisdiction.

1.07 QUALITY ASSURANCE

A. Installer Qualifications. A qualified landscape or tree removal company whose work has resulted in successful selective clearing of invasive plant material and renovation of established native landscapes. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals, the Ohio Nursery and Landscape Association or the American Nursery and Landscape Association.
2. Experience: Five years' experience in related or similar native plant restoration.

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:
    a. Landscape Industry Certified Technician - Exterior.
5. Pesticide Applicator: State licensed, commercial.

B. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include diagrams and written procedures for the removal and clearing of invasive plant materials, designated understory plants and fallen debris. Provide coordinated schedule with scope of the arborists and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

C. Owners Representative to be on site during selective removal operations. Do not proceed with work until the Owners Representative is on site and given the authorization to proceed with work.

1.08 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic-ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service, Call Before You Dig for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion and sedimentation control and plant-protection measures are in place.

D. Tree and Plant Protection Zones: Protect according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.01 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

1. Glyphosate Herbicide

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

D. Prior to entering the tree protection zone, coordinate with the owner's representative to enter tree protection zone.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion and sedimentation control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.03 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

3.04 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Landscape Architect not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Landscape Architect's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

3.05 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Remove all invasive bush honeysuckle (Lonicera sp.) and tree-of-heaven (Ailanthus altissima) saplings and trees and any other non-native plants within the area indicated in the field designate Clearing Zone.

3. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.

4. Use only hand methods or air spade for grubbing within protection zones.

5. Apply water-based glyphosate herbicide (trade name rodeo, accord, or approved equal) to the cut surface of shrubs, trees, and vines immediately (within 3 minutes) after cutting.

a. Apply at least 40% of active ingredient. A 100% solution is recommended for best results, following specifications provided on product label. Include colored dye in herbicide for visual application limits.

b. Apply the herbicide directly to the freshly cut surface using a hand-held sprayer or paintbrush. Care should be taken not to apply herbicide to adjacent native vegetation.

c. After 14 days from herbicide application, inspect application area for live weeds. If live weeds persist, reapply herbicide as required to eliminate all live invasive plants.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.06 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil. Sod removal shall include the entire root system but not an excess amount of topsoil.

B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

2. Inspection of topsoil by Landscape Architect is required.

C. Stripping and stockpiling topsoil shall be done under reasonably dry conditions. Stripping and stockpiling under wet conditions will not be allowed.

D. Contractor shall strip available topsoil to its full depth from within the Contract limits, excluding areas in close proximity to trees designated to remain, unless otherwise specified or directed by the Landscape Architect.

E. Contractor shall stockpile topsoil in a storage pile in an area shown on the Drawings or as directed by the Landscape Architect. Storage pile shall be shaped to freely drain surface water during and after stockpiling operations.

F. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.

2. Do not stockpile topsoil within protection zones.

3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.07 SITE IMPROVEMENTS

A. Remove existing above and below grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

3.08 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Burning tree, shrub, and other vegetation waste is **not** permitted according to burning requirements and permitting of authorities having jurisdiction.

3.09 MAINTENANCE

A. Return to site 90 and 180 days after clearing areas. Reapply herbicide as required and to manufacturer's specification to eliminate any new or live invasive plants.

END OF SECTION

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SECTION 31 22 19

FINISH GRADING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section applies to the final subgrade preparation, placement of Soil Mixes and amending of in-place (In-Situ), standard processed topsoil planting mix and bioretention soils preparation, amendments, and hauling.

1.02 SUMMARY

A. This Section includes the following:

1. Preparation of subgrade soils in planting areas for each specified soil mix and type.
    a. Includes ripping of subgrade and in situ soils, and debris removal.
2. Placement of Stockpiled Soils.
3. Placement of Soil Mix ('s) and Amendments.
4. Fine Grading of Turfgrass and Planting Area Soil Surfaces.

1.03 REFERENCES

A. ASTM- ASTM International: D 1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

B. EPA – Environmental Protection Agency:

1. Method 8015.
2. Method 8020.

C. SSSA – Soil Science Society of America, Inc.

1. Methods of Soil Analysis Part 1 – Physical and Mineralogical Methods, 1986.
2. Methods of Soil Analysis Part 3 – Chemical Methods, 1996.

D. USDA – United States Department of Agriculture:

1. Texture Triangle Classification.
2. Handbook No. 60.

1.04 DEFINITIONS

A. Acceptance, Acceptable, or Accepted: Acceptance by the Landscape Architect in writing.

B. Aesthetic Acceptance of Grades: Acceptance by the Landscape Architect in writing of the aesthetic correctness of the contours. Aesthetic acceptance does not address whether areas drain properly, are at the correct elevations, or whether the soil has been compacted properly.

C. Backfill: Soil material or controlled low-strength material used to fill an excavation.

D. Debris or Deleterious Materials: Elements including, but not limited to concrete, concrete masonry, wood, excavated rock and rock fragments, rubble, overburden soils, abandoned utility structures, trash, refuse and litter.

E. Excessive Compaction: Planting area soil or soil compaction greater than 75 percent maximum dry density as determined by ASTM D 1557.

F. Finished Grades: The required final soil surface elevations and contours indicated on the Drawings.

G. Planting Soil Mix: A specified profile of soil system components, such as soil, sand and compost homogeneously blended to produce a specified planting soil mix.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or soil materials.

J. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically soil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

K. Transition Layer: The specified planting soil mix for a planting area is homogeneously blended into the existing (ripped) native soil substrate to create a “transition” layer between the subgrade and specified planting soil mix. Transition layers vary pending specified soil mix for each planting area.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Installation foreman on the job shall be competent English-speaking supervisor(s), experienced in planting soil preparation for lawn and planting installations. The supervisor shall remain on the site during the entire installation process.

2. Testing Laboratory: Experienced person (s) employed by public or private testing laboratory, qualified and capable of performing tests, making soil recommendations, and issuing reports as specified. The Testing Laboratory shall submit a Statement of Qualifications regarding the specified testing. The Testing Laboratory shall be as approved by the Landscape Architect.

3. It shall be the responsibility of the Contractor to see that the specifications are being adhered to. Failure of the Landscape Architect to immediately reject unsatisfactory workmanship or to notify the Contractor of his/her deviation from the specifications shall not relieve the Contractor of his/her responsibility to repair and/or replace unsatisfactory work.

B. Pre-Installation Conferences: Person(s) responsible for soil preparation and mixes of this Section shall attend Pre-Installation Conference(s) to coordinate with work of other sections.

C. Finished Grading Smoothness Mock-Up:

1. Prepare a 20-foot by 20-foot area of finished graded soil representing the finished graded surface of the planting areas.

2. Locate mockup on site in an area easily referenced during fine grading operations.

3. Protect accepted mockup from physical damage and erosion until date of Final Completion.

4. The accepted mockup shall be the standard by which finish grading will be judged.

D. The Landscape Architect reserves the right to inspect and test grading operations at any time and as deemed necessary for verification of conformance to specification requirements. Any subsurface or grading conditions not meeting the requirements of the Specifications to be corrected by the Contractor before continuing with any further operation of the project and at no cost to the project.

1.06 PROJECT CONDITIONS

A. Examination: Promptly notify Construction Manager and Landscape Architect of unexpected subsurface conditions. Discontinue work until notification to resume work is provided by the Construction Manager.

B. Environmental Requirements:

1. Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily.

2. Apply water, if necessary, to bring soil to optimum moisture content for fine grading operations.

3. Do not perform fine grading work when subgrade and/or soil is muddy or frozen.

C. Existing Conditions:

1. Locate existing underground utilities in areas of work. If utilities are indicated to remain in place, provide adequate means of support and protection during fine grading operations.

2. If uncharted, or incorrectly charted, piping, or other utilities are encountered during the Work, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

3. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Construction Manager and then only after acceptable temporary utility services have been provided.

4. Provide a minimum of 48-hour notice to Construction Manager and receive written notice to proceed before interrupting any utility.

5. Contact the Local Utilities Protection Service before commencement.

1.07 SEQUENCING

A. Soil Placement: In order to prevent excessive soil compaction, avoid placing soil in areas subject to construction vehicle and equipment traffic. Coordinate the work of this section with other project work as contained in all other Sections of the project specifications.

PART 2 - PRODUCTS

2.01 SOILS

A. Refer to Sections 32 91 00 through 32 91 50 for Soil Mixes.

PART 3 - EXECUTION

3.01 FIELD ENGINEERING

A. General:

1. Provide all layout work required. Establish extent of fine grading by area and elevation; designate and identify datum elevation and project engineering reference points. Set required lines, levels, and elevations.

2. Provide as many grade stakes and string lines as required to achieve smooth finish grades acceptable to the Landscape Architect. Mark each stake to indicate design finished grade indicated.

B. High Points and Low Points: Install grade stakes at high points and low points including top of berms, catch basins and area drain rims.

3.02 EXAMINATION

A. Examine areas and conditions under which work is to be performed. Obtain and examine the records and drawings of adjacent work and of existing utilities and their connections for conditions which may affect the work under this Section.

B. Verify all work requiring access through or adjacent to areas where each planting soil mix is to be placed has been completed and no further access will be required. If access is required, this must be coordinated with the Contractor.

C. Confirm subgrade is clear of all construction debris, trash, rubble, and any foreign material. If fuels, oils, concrete washout silts or other material harmful to plants have been spilled into the subgrade material, excavate the soil sufficiently to remove the harmful material. Fill any over excavation with approved fill and compact to the required subgrade compaction.

D. Confirm subgrade is at the proper elevation, parallel to the finished grade and compacted as shown on the drawings.

E. Verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.

F. Excessive Compaction: Verify subgrade in planting area is not excessively compacted.

G. Soil Preparation: Verify off-site soil preparation is complete and ready for transporting to site.

H. Notify Landscape Architect of any unacceptable sub-grade conditions. Do not start the installation of the soil mix until sub-grade conditions have been corrected.

3.03 PREPARATION

A. Review soil analysis testing results and requirements needed for each specified soil mix and amendment. Testing Agency recommendations may vary and require the contractor to provide additional testing or preparations prior to placement of soils.

B. Protection of Existing Conditions:

1. Protect structures, utilities, sidewalks, pavements, irrigation systems, paving, plant materials, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by fine grading operations.

2. Provide barricades, fences, or other barriers to protect existing conditions to remain from damage during construction.

3. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.

4. Do not store material or equipment, permit burning, or operate or park equipment under the branches of existing trees to remain.

5. Submit written notification of conditions damaged during construction immediately to the Owner's Representative.

C. Assure all grass and weed growth has been extinguished prior to placing the specified soil mix as indicated on the drawings. Respray areas still exhibiting grass, weed, or other plant growth. Follow manufacturer's recommendation for allowing grass and weed control to properly kill vegetation prior to amending soils.

D. De-compact sub-grade soils and in situ soils by soil ripping.

1. Prior to placing stockpiled soils and each specified soil mix or, rip areas to receive the specified soil on the same day soil mix is placed.

2. Rip subgrade to a depth of 6 inches. Place ripping tines at 18 inches on center.

3. Make second ripping pass in the direction 90 degrees to the direction of the first ripping pass.

4. Do not rip closer than 24 inches to installed underground utility lines and structures.

5. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so soil material will bond with existing material.

6. Once the subgrade is ripped, only equipment with a ground pressure not to exceed 4.5 p.s.i. shall be used, ex. padded, wide-tracked LGP rated dozers and/or excavators, small to medium tractors with turf tires, etc.

E. Transition Layer:

1. Uniformly place 3 inches or as designated by the drawings, the specified soil over the ripped areas. Using mechanical equipment, blend the specified soil into the ripped subgrade approx. 2-4 inches in depth or as designated on the drawings.

2. Do not place final lifts of specified soil until the Transition Layer has been blended.
3. Remove any debris (see Definitions) greater than 1 inch in diameter or 2 inches in length that has been worked to the surface of the transition zone.
4. Tree Root Protection
    a. All work infringing on root systems of existing plant material shall be reviewed and approved by the Landscape Architect prior to beginning work.
    b. Protect tree root systems from damage adjacent to soil work where ripping is required.
    c. Soil ripping may not be conducted when existing roots are in the immediate vicinity. All work infringing on root systems of existing plant material shall be reviewed and approved by the Landscape Architect prior to beginning work.
    d. Where tree roots are present within the designated soils zone, carefully blend native soils with the Compost using hand tools.

F. Uniformly moisten or aerate Transition Layer before compaction to within 2 percent of optimum moisture content.

3.04 PLACEMENT OF SOIL MIXES (INCLUDING ON-SITE STOCKPILED SOILS)

A. Verify proper placement and blending of Transitions Layer has been completed.

B. Lightly scarify Transition Layer prior to placing stockpiled soils or the specified soil mix.

C. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

D. Remove and replace or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

E. Verify placement locations and depths for stockpiled soil and for each specified soil mix and type.

F. Place the specified planting soil or mix in 6-inch lifts over the Transition Layer to the depths specified on the drawings.

G. Carefully settle soils to eliminate air pockets and to minimize future settling. Lightly scarify previously placed lift surfaces prior to placing subsequent lifts.

H. Compact each lift by applying enough water to achieve optimum moisture allowing consolidation and locking of soil particles.

1. A vibratory plate compactor, or other suitable method, shall be used to achieve greater than 80 to 85 percent maximum dry density as determined by the Standard Proctor Test ASTM D698-12. Moisture content and compaction shall be verified using ASTM D6938-15.
2. After any additional settlement has occurred, restore areas to finished grade prior to additional work within the area commencing.

I. For Lawn Areas, roll the whole surface of lawn bed with a hand roller weighing approximately one hundred pounds (100 lb.) per foot (12”) of roller width. Fill all depressions caused by

compaction operations with additional soil and re-grade. Lightly roll and rake until the surface presents a smooth, even, uniform in finish and to grade.

J. Backfill for Trees: Unless noted otherwise or approved in writing by Landscape Architect, the excavated tree pit soil **is not** acceptable backfill material for trees. Remove excavated soil from site and use specified soil mix in this section. Install as specified in Section 32 93 00 "Plants" and per drawing details. Placing, shoring, or anchoring is the responsibility of the Contractor.

K. Protect areas where soil has been placed and prepared against construction activity with site protection fence. See Section 32 92 00 Turf Grass and Sod for additional protection.

3.05 AMENDING IN SITU AND REDISTRIBUTED STOCKPILED SOIL

A. Uniformly grade In Situ and Redistributed Stockpiled Soil areas to within "Finish Grade" tolerances.

B. Rip soil surfaces of In Situ and Redistributed Stockpiled soils.

1. Rip to a depth of 6 inches. Place ripping tines at 18 inches on center.

2. Make second ripping pass in the direction 90 degrees to the direction of the first ripping pass.

C. Provide approved Organic Compost at the locations indicated on the Contract Drawings per the Testing Agency recommendations.

1. To establish baseline Bid Quantities, provide 3-inch depth of approved organic compost to areas where existing soils have been ripped or tilled to 6-inch depth, (Equivalent to 1 cu. yd compost for every 108 sq. ft.).

2. Actual compost mix ratio volumes will be established upon completion of the testing of the existing soil and compost. The controlling factor will be the percent (%) organic matter by weight as specified for the specified soil system profile.

a. Organic Level for Turfgrass Areas: 3 to 5 percent

b. The intended volume ratios of the Organic Amendment (compost) components will be, in large part, determined by the organic matter content of the compost. Follow the recommendations on mix design provided by the soil testing laboratory to achieve the target organic matter content for the soil mix.

D. All amendments shall be in proper condition (moisture content, loose and friable condition) to be able to be spread evenly when dropped or spread on existing soils.

1. Additional amendments shall be mixed into the soil bed as recommended by the testing laboratory and as approved by the Landscape Architect for each plant type and condition of installation.

2. Adequate quantities of compost mix materials shall be provided to attain, after compaction and natural settlement, all design finish grades. Verify quantities for placement as specified to suit site conditions.

E. Uniformly mix components using a mechanical soil tiller designed for such purpose as specified for depths as shown on the drawings. Unless noted on the drawings, provide 6-inch minimum tilling depth, 3 inches soil bed plus 3 inches compost.

F. Method of settlement shall be as previously approved by the Landscape Architect. Method may include, but is not limited to, natural settlement over an approved period or light hand-tamp, light rolling or the use of a light-weight plate compactor with the number of passes approved by the Landscape Architect.

1. Compact to 80-85% Proctor ASTM D698 (latest version), as measured with a nuclear densitometer. Testing shall be conducted for every 500 cu. yds. of compost placement.
2. Allow amended soil in lawn areas to remain undisturbed until fully settled in accordance with settlement methodology submitted as approved by the Owner's Representative.
3. After settlement has occurred, add amended soil to maintain finished grades. If for any reason mix area is left exposed for a long duration prior to planting, add native soil, amend and re-grade as required if erosion occurs. Fills shall not be so compacted as to in any way restrict the flow of water or air through the soil.
4. After any additional settlement has occurred, restore areas to finished grade prior to seeding or planting.

G. Protect areas where soil has been placed and prepared against construction activity with site protection fence. See Section 32 92 00 Turf Grass and Sod for additional protection.

3.06 FINISH GRADING

A. Perform grading within contract limits, including adjacent transition areas, to new elevations, levels, profiles, and contours indicated. Provide subgrade surfaces parallel to finished surface grades. Provide uniform levels and slopes between new elevations and existing grades.

B. General:

1. Uniformly grade areas to a smooth uniform surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
2. Provide a smooth transition between adjacent existing grades and new grades.
3. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
4. Slope finish grades to drain surface water away from buildings, walks, paving, and other structures unless indicated otherwise.
5. Slope finish grades to drain surface water to drainage swales, catch basins, area drains, or trench drains as shown on the Drawings.
6. Grade soil surface smooth to be free of high and low areas which will inhibit surface drainage.

7. Grade the soil surface at the edges of lawn areas, along paving areas, and curbs to an elevation 1 inch below the finished surface of adjacent paving and curbs, unless indicated otherwise.
8. Hand-rake soil surface using screed boards, string lines, and laser levels to achieve smooth surfaces acceptable to the Landscape Architect.

C. Equipment: Use equipment and hand tools of appropriate size and type to achieve the profiles, and a smooth soil surface free of high areas, depressions, equipment tracks, and excessive compaction.

D. Depressions and Loose Material: Fill any depressions and remove loose material to finish surface true to line and grade, presenting a smooth and unyielding surface.

E. Excessive Compaction:

1. Take precautions to prevent finished graded surfaces from becoming excessively compacted.
2. Protect finished graded surfaces from excessive compaction from vehicular, equipment, and foot traffic by laying down planks, plywood, or other accepted protective devices.
3. Do not store or stockpile materials on finished graded surfaces.
4. Mechanically loosen excessively compacted soil areas to full depth.

3.07 TOLERANCES

A. Planting Areas:

1. Grade soil surface to within 0.05-foot of grades indicated on the Drawings, except bring soil surface grades along paving, curbs, and other structures to within 0.01-foot of grades indicated on the Drawings.
2. Transition soil surface grades along paving, curbs, and other structures to areas of less strict tolerance over a 5-foot distance.

B. Allowances: Make proper allowances for settlement.

3.08 ADJUSTING

A. Soil Finished Grade:

1. Provide allowance for 32 hours of adjustment grading work with a 4-person hand-grading crew to smooth and shape the soil surfaces using hand rakes, shovels, and other hand tools.
2. After the soil surface elevations have been graded to be within the specified tolerances, perform adjustment grading Work under the direction of the Landscape Architect in the field.
3. Do not rely on adjustment grading to bring finished grade elevations to within specified tolerances.

3.09 FIELD QUALITY CONTROL

A. Aesthetic Acceptance of Grades:

1. Upon completion of finish grading Work, schedule a review by the Landscape Architect to obtain aesthetic acceptance.
2. Provide 3 days advance written notification.
3. Do not commence seeding, sodding, or other planting Work until receiving aesthetic acceptance in writing.

B. Test for Excessive Compaction:

1. Where excessive compaction is suspected by Landscape Architect, have a Geotechnical Engineer perform nuclear density field tests.
2. Correct excessively compacted soil areas to the depth of the excessive compaction by means and methods acceptable to the Landscape Architect prior to installing plant material.

3.10 PROTECTION

A. Protecting Fine Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where, completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Scarify or remove and replace soil material to depth as directed by Soils Engineer; reshape and recompact.

D. Repair erosion that occurs before and during plant or lawn installation.

E. During construction, maintain temporary soil erosion and sedimentation control measures in place. Inspect, repair, and replace damaged or missing items as work progresses.

3.11 DISPOSAL AND CLEAN UP

A. Promptly remove soil and debris created by soil work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Legally dispose of off-site all refuse and debris from these operations. Do not dump or burn materials on site.

C. Maintain the site in an orderly condition during the progress of the Work. Continuously and promptly remove excess waste materials; keep lawn areas, walks, and roads clear. Store materials and equipment where directed. Promptly remove equipment, surplus materials, and debris and trash resulting from operations under this Contract upon completion and prior to initial acceptance or Work. Leave the site in a neat, order condition “broom clean”.

END OF SECTION

CML BARNETT BRANCH LIBRARY ADDITION/RENOVATION

3434 East Livingston Avenue

Columbus, OH 43227

SECTION 32 13 13

CONCRETE PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes exterior cement concrete pavement for the following:

1. CP1: Pedestrian Concrete Pavement with a light broom finish.
2. CP2: Heavy Duty Concrete Pavement with a medium broom finish.
3. C1: Concrete 18” Straight Curb.
4. Curing and/or Sealing.

1.02 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

B. Construction Joint: Joint produced when one pour is placed up against an existing one (cold joint)

C. Contraction Joint: Joint produced that isolates the crack (control joint).

D. Isolation Joint: Joint containing expansion material and/or caulking material to allow the joint to “flex” based on air temperature (expansion joint). Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

E. W/C Ratio: The ratio by weight of water to cementitious materials.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:
    a. Concrete mixture design.
2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
    a. Contractor's superintendent.
    b. Concrete paving Subcontractor.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer, ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Curing and Sealing compounds.
3. Joint fillers.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

E. Minutes of Preinstallation conference.

1.06 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Installer Qualifications:

1. Minimum of five (5) years' experience installing finished concrete paving in climates that experience seasonal freeze-thaw cycles.
2. Installer shall demonstrate minimum of five (5) years successful experience installing exposed/seeded aggregate special finish concrete paving and cite five (5) successful installations in climates within the same climate region as the project. At least one project shall be 3,000 sf minimum. For each project, include the following information:
    a. Project description
    b. Project location
    c. Date of installation

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship and as indicated in the pre-construction meeting.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Landscape Architect and not less than 96 inches by 96 inches**.**
3. Where concrete is called to be sealed, seal one half of the mockup area for color and finish review by Landscape Architect.
4. Notify Landscape Architect as soon as possible in advance of dates and times when mockups will be constructed.
5. Obtain Landscape Architect's approval of mockups before starting construction.
6. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
7. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Landscape Architect specifically approves such deviations in writing.
8. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms**[, steel reinforcement,]** and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.01 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.02 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.03 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C150, Gray Portland cement Type II, Type I/II, Type III.

a. Type III - High early strength may be used with written approval and at the contractor's expense.

2. Fly Ash: ASTM C618, Class C or Class F.

3. Slag Cement: ASTM C989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C33, Class 4S, uniformly graded. Provide aggregates from a single source throughout entire project. Provide aggregates free of iron pyrite.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Air-Entraining Admixture: ASTM C260.

D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C494, Type A.

2. Retarding Admixture: ASTM C494, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C494, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

E. Water: Potable and complying with ASTM C94.

2.04 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Dayton Superior Corporation: Sure Film.
    b. Euclid Chemical Company (The): Eucobar.
    c. L&M Construction Chemicals, Inc.: E-con.
    d. Meadows, W. R., Inc.: Sealtight Evapre.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating. (Standard Broom Finishes)

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
    b. Euclid Chemical Company (The); Kurez DR VOX.
    c. L&M Construction Chemicals, Inc.; L&M Cure R.
    d. Meadows, W. R., Inc.; Series 1100.
2. The curing compound shall not be used as the final sealer for the concrete.
3. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

F. White Curing Compound - Waterborne, Membrane-Forming: ASTM C309, Type 2, Class B, dissipating.

2.05 CURING AND SEALING – MEMBRANE FORMING

A. Clear Curing and Sealing Compound – Acrylic, Water Based or Solvent-Borne, Membrane-Forming: ASTM C1315, Type 1, Class A. Manufactured for use with standard broom finished concrete, and colored concrete.

1. Products: Subject to compliance with requirements, provide one of the following:
    a. BASF Corporation;

1) MasterKure CC 250 SB or MasterKure CC 250 XS (25% solids - Semi Gloss)

b. Dayton Superior;

1) Cure & Seal 1315 EF (30% solids - clear / satin finish)

c. Euclid Chemical Company (The); an RPM company;

1) EverClear or EverClear 350 (25% Solids - Medium gloss finish and can be tinted)

2) Luster Seal 300 (25% Solids - Satin finish and can be tinted)

d. W.R. Meadows, Inc;

1) CS-309-30 (Attractive Sheen)

2.06 SURFACE SEALING (POST 28 DAY CURING)

A. Clear - Silane/Siloxane Water Repellent: Penetrating sealer for concrete and masonry, including concrete block, clay and concrete brick surfaces, both horizontal and vertical surfaces.

1. Silane/Siloxane, Silane- or water-based products for use include but are not limited to the following:

a. Prosoco, Inc. - 'Salt Guard'

b. Dayton Superior Co. - 'Weather Worker 40%

c. Other – approved equal.

2. Per requirements, seal concrete surfaces at the end of the 28-day curing period.

2.07 WATER REPELLENT:

A. Penetrating Water Repellent Sealer:

1. Penetrating Water Repellent: Clear penetrating sealer consisting of 100% silane and meeting the following criteria:

a. Flash Point: 145 Deg F.

b. NCHRP No. 244 Reduction in Chloride Content

1) Average: 91%

2) Minimum Required: 75%

c. NCHRP No. 244 Reduction in water absorption

1) 1-Day in Water: 94%

2) 3-Day in Water: 89%

d. VOC's: 248 g/l

e. Average Depth of Penetration: 0.2"

2. Product:

a. Euclid Chemical Company (The): Baracade Silane 100 C www.euclidchemical.com.

2.08 RELATED MATERIALS

A. Expansion and Isolation-Joint-Filler Strips: ASTM D 1752, Provide with joint caps.

1. Basis of design: Products by WR Meadows.
    a. Cork: ASTM-D1752 Type II.
    b. Typical Thickness: 1/4 inch.
    c. Joint Cap: Two-piece device with upper portion removable after curing period; width corresponding to joint filler.
2. Plastic strips with a removable top for placing caulking or sealant that is designed specifically for expansion between concrete pours.

2.09 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures, and obtain laboratory test results that comply with or exceed requirements.

B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 6 percent plus or minus 1-1/2 percent for 1-inch nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture, high-range, water-reducing admixture, high-range, water-reducing and retarding admixture, plasticizing and retarding admixture in concrete as required for placement and workability.

F. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 4000 psi.
2. Maximum W/C Ratio at Point of Placement: 0.45.
3. Slump Limit: 5 inches, plus or minus 1 inch.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

1. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.

2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 31 20 00 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.04 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints (Cold Joints): Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

2. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

C. Isolation Joints (Expansion Joints): Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals as shown, unless otherwise indicated.

2. Extend joint fillers full width and depth of joint.

3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.

4. Place the top of joint filler flush with finished concrete surface if joint sealant is not indicated.

5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. During concrete placement, protect the top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints (Control Joints): Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

a. Curbs and Gutters: Provide saw cut joints at 10 ft on-center unless noted otherwise. Through-cut top 6 inches of straight curb.

b. Walks, Walls, and Concrete Paved Surfaces: Refer to drawings for details and general layout.

c. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Do not re-tool edges after applying surface finishes. Eliminate tool marks on concrete surfaces. “Picture Framing” tooling anywhere is not to be done, unless noted.

3.05 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. When adjoining pavements are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength. Do not drive vehicles on pavement until the full 28-day strength is attained.

K. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.06 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Curbs and Edge Restraints: Provide monolithic finish by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.07 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Bull Float Finish: After striking off initial pour of concrete, begin the second floating operation when bleed water sheen has disappeared, and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or

inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

3.08 BROOM FINISH

A. Monolithic Broom Finish: After bull floating concrete surface and prior to applying curing compound or curing and sealing compounds, provide a monolithic broom finished concrete surface as specified below.

1. Fine Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

2. Medium Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.09 CONCRETE PROTECTION, CURING AND SEALING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: For standard concrete work and “Float” and “Broom Finished” concrete surfaces, cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.

   b. Continuous water-fog spray.

   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12-inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

4. Curing and Sealing Compound (C & S): Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat the process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

F. Clear Silane/Siloxane Penetrating Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions. Allow first coat to dry before applying second coat, at 90 degrees to the direction of the first coat, using same application methods and rates.

1. Seal finished concrete only after the 28-day curing period has expired with 2 coats of penetrating sealer at the recommended manufacturer’s rate.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8-inch, minus 1/4 inch.
3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/4 inch.
4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100-cu. yd. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39; test one specimen at seven days and two specimens at 28 days.
    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Landscape Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Landscape Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Landscape Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.12 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Landscape Architect.

B. Drill test cores, where directed by Landscape Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

CML BARNETT BRANCH LIBRARY ADDITION/RENOVATION

3434 East Livingston Avenue

Columbus, OH 43227

SECTION 32 13 73

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Cold-applied, fuel-resistant joint sealants.
3. Joint-sealant backer materials.
4. Primers.

B. Related Requirements:

1. Section 32 13 13 - Concrete Paving" for constructing joints in concrete pavement.

1.02 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site with Landscape Architect to review methods and procedures related to joint sealants, including but not limited to, the following:

a. Quality control of application and construction practices.

b. Mockup requirements.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.04 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of joint sealant and accessory.

B. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by the manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

C. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Mock-ups: See Section 32 13 13 “Concrete Paving” for mock-up requirements. Provide for each type of pavement finish a minimum 4 ft continuous run of specified expansion material, full depth and color unless otherwise directed by Landscape Architect.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.07 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.

2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers include but are not limited to the following:

1. Dow Chemical.

2. WR Meadows.

3. Mameco International.

4. Sika.
5. Sonneborn.

2.02 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Landscape Architect from manufacturer's full range.

2.03 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893/D5893M, Type SL.

C. Multicomponent, non-sag, polyurethane elastomeric sealant for Concrete: Pourable, chemically curing elastomeric formulation complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated:

1. Urethane Formulation: Type M; Grade NS; Class 25; Uses T, NT M, and, as applicable to joint substrates indicated, O.
    a. Available Products:
        1) Sika Corporation; Sikaflex – 2c NS.
        2) 'DynaTred' by Pecora, Harleysville, PA; (800) 523-6688, (215) 723-6051; www.pecora.com.
    b. Color: To be selected by Landscape Architect from manufacturer's "Color Pack" system.
2. Or approved equal by Landscape Architect Single-Component, Nonsag, Silicone Joint Sealant: ASTM D 5893, Type NS.

2.04 COLD-APPLIED, FUEL-RESISTANT JOINT SEALANTS

A. Fuel-Resistant, Single-Component, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

B. Fuel-Resistant, Multicomponent, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade P, Class 12-1/2 or 25, for Use T.

2.05 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.06 JOINT-SEALANT TOPPING MATERIAL

A. Topping material: Finishing Sand. Specially treated super-fine sand (Silica Sand) that has been washed, filtered for even particles and heat dried to reduce weight so it does not sink and spreads evenly over the surface of the caulk.

1. Approved Manufacturer:

a. Basis for Design: Seal Green – Reuse Concrete Sealing Specialist, LLC 16072 Foster Street, Overland Park, KS 66085, Phone: 800-997-3873.

b. Color: Contractor to provide samples of entire color range of manufacturer’s selection to Landscape Architect for selection and approval.

2.07 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.03 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

H. Apply topping material over fresh joint sealant while it is still sticky at the surface.

3.04 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint

sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion.

B. Cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION

CML BARNETT BRANCH LIBRARY ADDITION/RENOVATION

3434 East Livingston Avenue

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SECTION 32 17 13

PARKING BLOCKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes concrete wheel stops. Refer to drawings for specific locations and quantities.

1.3 ACTION SUBMITTALS

A. Product Data: Precast concrete wheel stops.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi minimum compressive strength, manufacturer's standard height and width by 72 inches long. Provide chamfered corners, and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.

1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
2. Surface Sealer: Manufacturer's standard salt-resistant, clear sealer, applied at precasting location.
3. Mounting Hardware: Galvanized-steel spike or dowel, 1/2-inch diameter, 10-inch minimum length.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wheel stops according to manufacturer's written instructions unless otherwise indicated.

B. Install wheel stops in bed of adhesive before anchoring.

C. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by the manufacturer. Recess head of hardware beneath top of wheel stop and hole grout solid.

END OF SECTION

CML BARNETT BRANCH LIBRARY ADDITION/RENOVATION

3434 East Livingston Avenue

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SECTION 32 33 00

SITE FURNISHINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. F1: Bike Rack.
2. F2: Steel Bollard.
3. F3: Trash and Recycling Receptacles.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for installing pipe sleeves cast in concrete footings.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of exposed finish, not less than 6-inch-long linear components and 4-inch-square sheet components.

C. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.03 INFORMATIONAL SUBMITTALS

A. Material Certificates: For site furnishings manufactured with preservative-treated wood.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to be included in maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Bench Replacement Slats: No fewer than two full-size units for each size indicated.
2. Trash Receptacle Inner Containers: Three full-size units for each size indicated. Where each container has two or more liners, provide Three of each size of liner.

PART 2 - PRODUCTS

2.01 F1: BIKE RACK

A. Manufacturer/Supplier: www.landscapeforms.com

B. Material: Cast aluminum frame.

C. Size: 31” height by 36” length.

D. Color: Powdercoated, color TBD.

E. Mount: Embedded in concrete surface.

2.02 F2: BOLLARD

A. Bollard Construction:

1. Round tube, 9” O.D.
2. Steel: Schedule 40.
3. Overall height: As per drawings.
4. Color: Painted, TBD
5. Mount: Embedded in concrete and concrete backfilled.

2.03 F3: TRASH AND RECYCLING RECEPTACLES

A. Manufacturer: www.sitepieces.com

B. Mode/Style: Monoline Litter Bin. SKU: ML-XXLITTER.

C. Material: Aluminum framed structure, plastic liner

D. Finish/Color: Polyester powder coat, TBD.

E. Size: 36 gallon capacity

F. Mount: Surface mount.

2.04 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:

1. Rolled or Cold-Finished Bars, Rods, and Wire: ASTM B211.
2. Extruded Bars, Rods, Wire, Profiles, and Tubes: ASTM B221.
3. Structural Pipe and Tube: ASTM B429.
4. Sheet and Plate: ASTM B209.
5. Castings: ASTM B26.

B. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A36.
2. Steel Pipe: Standard-weight steel pipe complying with ASTM A53, or electric-resistance-welded pipe complying with ASTM A135.
3. Tubing: Cold-formed steel tubing complying with ASTM A500.
4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A513, or steel tubing fabricated from steel complying with

ASTM A1011 and complying with dimensional tolerances in ASTM A500; zinc coated internally and externally.

5. Sheet: Commercial steel sheet complying with ASTM A1011.
6. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F1267.
7. Malleable-Iron Castings: ASTM A47, grade as recommended by fabricator for type of use intended.
8. Gray-Iron Castings: ASTM A48, Class 200.

C. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.

1. Polyethylene: Fabricated from virgin plastic HDPE resin.

D. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials; commercial quality, tamperproof, vandal and theft resistant.

1. Angle Anchors: For inconspicuously bolting legs of site furnishings to on below-grade substrate; as per manufacturer.
2. Antitheft Hold-Down Brackets: For securing site furnishings to substrate.

E. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107; recommended in writing by manufacturer, for exterior applications.

F. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

2.05 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

E. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.06 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.07 ALUMINUM FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.08 STEEL AND GALVANIZED-STEEL FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

2.09 IRON FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored and positioned at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set

plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION

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SECTION 32 91 00

AMENDED IN PLACE SOILS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This Section applies to testing In Situ and Stockpiled soils, and the manufacturing, and delivery of the amendment materials required per testing analysis results. Refer to Section 32 20 19 – Finish Grading for subgrade preparation, placement, and final grading.

B. Coordinate Work with that of other trades affecting or affected by Work of this Section and cooperate to assure the steady progress of Work.

1.02 SUMMARY

A. Section Includes:

1. All labor, materials, equipment, and testing requirements necessary to furnish and mix the specified amendments to the in situ and redistributed stockpiled soils as shown on the drawings and specified herein, including but not necessarily limited to the following:

    a. Perform soil analysis test to existing In Situ and Stockpiled soils for requirements contained herein.

    b. Construct the amended Soil System profiles using the specified materials and techniques as recommended by the Testing Agency reports contained herein and on the drawings.

2. Test, furnish, and deliver all organic amendment (compost) materials, and any other soil amendments for use in amending existing soils or as sections shown on the drawings.

1.03 REFERENCES AND STANDARDS

A. The following references are used herein and shall mean:

1. ASTM: American Society of Testing Materials
2. NCR221: Recommended Soil Testing Procedures for the North Central Region
3. SSSA: Soil Science of America, Methods of Soil Analysis, Part 1 & Part 3
4. TMECC: Test Methods for the Examination of Composting and Compost
5. USDA: United States Department of Agriculture
6. USEPA: United States Environmental Protection Agency

B. Standard Specifications: Regional, State or Municipal Standard Specification Documentations for the location of proposed usage.

1.04 DEFINITIONS

A. Compost: An organic material that has been aerobically composted and stabilized from feedstocks such as green waste (yard debris), biosolids or other suitable organic materials.

B. Com-til: Composted biosolids material available from the City of Columbus specifically for the purpose of applying to and amending existing soils via a tilling operation. Com-til Plus material shall not be used.

C. Debris or Deleterious Materials: Elements including, but not limited to concrete, masonry, wood, excavated rock and rock fragments, rubble, overburden soils, abandoned utility structures, trash, refuse, and litter.

D. Finish Grade: Elevation of finished surface of a Soil System after specified compaction and natural settling.

E. Soil: A mineral soil from the A Horizon or B Horizon of a well-drained site and having a USDA soil texture classification of a Clay or Clay Loam and an organic matter content of not greater than 3% by weight as specified below.

F. Soil System: Exclusive to this technical spec section, a profile consisting of the native topsoil blended with an approved composted material.

G. Subgrade: Surface or elevation of subsoil remaining after completing excavation or backfill of soils or other materials immediately beneath transition mix or a planting mix or other Soil System.

1.05 SUBMITTALS

A. Refer to and comply with specifications for submittal procedures and criteria.

B. Product Data: Submit technical descriptive data for each manufactured or packaged product of this Section. Include manufacturer's product testing and analysis and installation instructions for manufactured or processed items and materials.

1. Locations: Submit locations of material sources. Submit location of mixing site(s).

C. Certificates: Submit certified analysis for each chemical soil amendment and fertilizer material specified (specimen label) and as used (product label). Including guaranteed analysis and weight for packaged materials.

D. In Situ and Stockpiled Native Soil Test Submittals: Engage an independent testing agency to qualify existing soil conditions. The Contractor shall submit representative samples of existing soils materials to an agricultural soil testing laboratory acceptable to the Landscape Architect. All soil tests shall be performed in accordance with the current methods provided by ASTM, SSSA or USEPA, unless otherwise noted. All reports prepared by the testing laboratory shall be sent to the Landscape Architect for approval. Deficiencies in the soil, shall be corrected by the Contractor, as directed by the Landscape Architect after review of the testing agency report. Test reports shall include the following:

1. Date issued.

2. Project Title and names of Contractor and supplier.

3. Testing laboratory name, address and telephone number, and name(s), as applicable, of each field inspector or laboratory contact.
4. Date, place, and time of sampling or test, with record of temperature and weather conditions.
5. Location of material source.
6. Type of test.
7. Results of tests including identification of deviations from acceptable ranges.
8. Soil pH and Buffer pH Test.
9. Particle size analysis shall be performed and compared to the USDA Soil Classification System per ASTM D422 (hydrometer test). The USDA sand and gravel classifications shall be determined on material retained on the #270 sieve following a wet washing procedure.
10. Deleterious materials shall be determined by ASTM D 5286.
11. Percent of organic matter by weight shall be determined by ASTM D 2974 Method C, loss on ignition at 440oC.
12. Saturated hydraulic conductivity shall be determined by ASTM F1815.
13. Analysis for nutrient levels in parts per millions or pound per acre including Nitrate Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Iron, Manganese, Zinc, Copper, Boron and Sodium as Exchangeable Sodium Percentage (ESP) per NCR221.
14. Cation Exchange Capacity (CEC) per NCR221 using the ammonium acetate method.
15. Soil analysis reports shall show recommendations for soil additives, including organic and inorganic soil amendments, necessary to accomplish mix objectives noted.

E. Compost Submittals

1. Report (s) of analyses from producers of composted organic materials are required. The compost shall be analyzed using the USCC STA test methods and reporting format, unless otherwise noted. Submit USCC STA Compost Technical Data Sheet for the delivered compost and dated within 9 months of delivery.
    a. Contact the testing laboratory to review testing and sampling requirements before sending samples.
2. Composted organic amendments shall be sampled according to the Ohio EPA State Law / Legislation Code: OAC Chapter 3745-24-46.
3. Maintain clear and concise records of testing and sampling procedures.

F. Testing Agencies: The following firms are acceptable testing agencies for the various components.

1. Soils and mixes shall be determined by an A2LA Accredited Lab, such as Turf Diagnostics and Design, 613 E. 1st Street, Linwood, KS, 66052, tel. 855-769-4231, www.turfdiag.com or other qualified soil physical testing laboratory approved by the Landscape Architect.
    a. Spectrum Analytic, 1087 Jamison Rd. NW, Washington Court House, OH 43160-8748,

tel. 800-321-1562 740-335-1562, www.spectrumanalytic.com.

b. Certified Local Agencies may be used pending approval by Landscape Architect.

2. Although the report(s) may contain the laboratory's comments or recommendations to the Landscape Architect regarding amendment requirements or procedures, the report shall not be interpreted as prescribing or dictating procedures or indicating quantities of soil materials for the work of this Contract.

3. Changing testing laboratories during the mix development phase or for quality assurance testing must be authorized by the Landscape Architect.

G. Statement(s) of Qualifications: Submit within 45 days of notice to proceed to confirm qualifications of the selected testing agencies.

H. Submit samples of all listed materials to the Landscape Architect for approval:

1. Compost, each source, 3 lb. packaged.

I. Submit for approval at least two weeks prior to installation a written plan for mixing, transporting, storing, placing, and settling installed materials.

1.06 QUALITY ASSURANCE

A. Mix component (s) will not be accepted unless they meet all submittal, testing and certification requirements including the testing and certification reports in the format specified herein.

B. Inspections and Testing

1. In Situ and Stockpiled Native Soils and Compost testing required in this Section or additionally required by the Landscape Architect shall be furnished and paid for by Contractor.

2. The Landscape Architect reserves the right to take and analyze at any time such additional samples of materials as deemed necessary for verification of conformance to specification requirements. The contractor shall furnish samples for this purpose upon request and shall perform testing as requested.

3. Samples that do not meet the Specifications will require the Contractor to re-submit additional samples for testing. Costs for re-testing will be the responsibility of the Contractor.

4. Observations and periodic testing will be made by the Owner or its designated representative on materials delivered to the site. Any soil mix that does not meet the requirements of the Specifications shall be removed or amended by the Contractor at no cost to the project.

5. As necessary, make any and all mix amendments to achieve the required specifications and resubmit tests reports indicating amendment changes until approved.

C. Qualifications

1. Testing Laboratory: Experienced person (s) employed by public or private testing laboratory, qualified and capable of performing tests, and issuing reports as specified. The

Testing Laboratory shall submit a Statement of Qualifications regarding the specified testing. The Testing Laboratory shall be as approved by the Landscape Architect.

2. It shall be the responsibility of the Contractor to see that the specifications are being adhered to. Failure of the Landscape Architect to immediately reject unsatisfactory workmanship or to notify the Contractor of his/her deviation from the specifications shall not relieve the Contractor of his/her responsibility to repair and/or replace unsatisfactory work.

D. Pre-Installation Conferences: Person(s) responsible for soil preparation and mixes of this Section shall attend Pre-Installation Conference(s) to coordinate with work of other sections.

1.07 PROJECT CONDITIONS

A. Should the Contractor, in the course of Work, find any discrepancies between Contract Drawings and physical conditions or any omissions or errors in Drawings, or in layout as furnished by the Owner, it will be Contractor's duty to inform the Construction Manager or General Contractor and Landscape Architect immediately in writing for clarification. Work done after such a discovery, unless authorized by the Landscape Architect, shall be done at the Contractor's risk.

B. Sequencing and Scheduling: Adjust, relate together, and otherwise coordinate work of this Section with other Project work as contained in all other Sections of the Project Specifications.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver packaged materials to the location where soils are to be mixed, in unopened bags or containers, each bearing the name, guarantee, and trademark or the producer, material composition, manufacturer’s certified analysis, and the weight or the material. Retain packages for the Landscape Architect.

B. Store and handle packaged materials in strict compliance with manufacturer’s instructions and recommendations. Protect all materials from weather, damage, and theft.

C. Amendment materials stored on site temporarily in stockpiles prior to placement shall be protected from intrusion of contaminants and erosion. All temporary storage means, and methods shall be approved by the Landscape Architect.

D. Stockpiling:

1. On-site and Certified Mixing Facility stockpiles should be restricted to no more than the needs of what can be used in a 72-hr. period. Under no circumstances shall on-site or off-site stored material exceed 500 cubic yards.

2. Stockpiles should be no more than 6 feet in height to prevent anaerobic conditions within the pile. Stockpiled composts should be turned every other week (unless otherwise instructed by the Landscape Architect) to prevent excessive water absorption and anaerobic conditions. Storage areas for soil shall be constructed on well drained land, away from the stream.

PART 2 - PRODUCTS

2.01 GENERAL

A. Contractor is responsible for collecting, handling, and testing samples from topsoil stockpiles and in situ soils.

B. Existing In Situ Soils shall be tested and amended in place.

C. Existing Stockpiled Soil, if present, to be tested, redistributed, and amended as required.

D. Mix components shall fulfill the requirements as specified.

E. Notifications:

1. Notify Landscape Architect 3 days prior to pulling field samples. Landscape Architect to be present and observe samples being taken.

2. Notify General Soils Lab to inform them that samples will be forthcoming, and to indicate the quantity of samples being sent, the reason for the testing, anticipated testing parameters and turnaround timeframe needed. Follow Lab instructions regarding taking of samples, drying, and bagging process, labeling each sample, general notes, etc.

2.02 IN-FIELD TESTING OF IN SITU SOILS (non-stockpiled)

A. Steps:

1. Each In Situ sample shall be a composite of several small core specimens as described below. Where conditions are relatively uniform, a minimum of two composite samples per acre will be required.

2. Visually divide the areas into sections based on variables such as:

a. Known or observed (variations in color/texture) soil types.

b. Different topography.

c. Observed or known past plant communities supported.

d. Different past usage (crops, sports field, fill area, etc.).

e. Obvious anomalies such as bare patches (to learn causes).

f. Do not sample areas with known hazardous material (s) contamination.

1) If the presence of hazardous material is not known but is suspected, do not sample without ascertaining that the area poses no hazard.

3. Provide a Soils Sample Plan identifying each area with a designation number, identifying characteristics of the area, number of samples taken and average depth of cores.

B. Within each section:

1. Dig or probe to determine the average depth of the existing topsoil layer. If this is neither feasible nor expeditious, use a default of six inches (6”).

2. Use a random number generating technique such as those described in ASTM D3665 (American Society for Testing and Materials) to determine the suitable frequency and horizontal distribution of core specimens required for each composite sample.

3. Remove surface debris, stones, etc. from sample areas.

4. Collect as many core specimens as determined appropriate for a given composite sample

(avoiding anomalies) and place them in a sample bag or other suitably sized container.

a. Typically, 5 to 15 core specimens per composite sample. Or one random sample per every 500 feet apart.

b. Do not take an excessive number of core specimens when topsoil conditions are obviously uniform.

c. Take core specimens no deeper than the depth of the topsoil layer or approximately up to 6" (a T-shaped metal hand probe works best, which would yield approximately a 1" diameter core; an alternative is a hand shovel).

5. Thoroughly mix the composite sample.
6. Line a plastic quart container with a clear plastic bag and place enough of this composite sample to completely fill the bag-lined container.
7. If testing of anomalies is desired, collect core specimens where the anomalies occur and keep them separate from the section composite sample (s). For each anomaly, collect enough soil to completely fill a standard bag-lined container as above.
8. Seal each container's plastic bag with the twist-tie.
9. Seal all containers, including the bagged samples.
10. Log all sample information into an Excel sheet. Include any "Remarks" as appropriate to indicate testing parameters (chose only from among those available - typically pH, organic matter (OM), texture and if needed, Nitrogen, Phosphorous and/or Potassium ("NPK") content).
11. Print and affix a label identifying the sample to the outside of the container. Keep careful track of sampling locations and label samples in a logical, meaningful manner.
12. Deliver or send all samples to the approved General Soils Lab unless approval in writing to deliver the samples to an alternate location has been obtained from the Landscape Architect.

2.03 IN-FIELD TESTING OF STOCKPILED SOILS

A. Stockpile/Salvaged soil to be tested prior to acceptance. Amend to soil test recommendations.

B. Stockpile/Salvaged soil must be well drained and taken from the A or B Horizon meeting the following requirements.

1. ASTM D 5286-92.
2. USDA soil classification of Clay Loam or Loam.
3. Organic matter content of not less than 3% by weight.
4. Sand Content of not less than 15%.
5. Maximum clay content of 42%.
6. pH range of 5.5 - 7.8.

C. Sampling Procedures for Stockpiles:

Topsoil Stockpile Vol. (CY)	Min. Num. of Samples Req'd.
Up to 500	One
Over 500 to 1000	Two
Over 1000 to 2000	Three
Over 2000 to 3000	Three
Over 3000 to 4000	Four
Over 4000 to 8000	Five

D. Steps

1. A stockpile will be visually divided into approximately equal sections, based on the number of samples to be taken. For example, a stockpile that requires three samples will be visually divided into thirds.
2. Within each section, the Contractor/Supplier shall:
    a. Remove all frozen material prior to sampling.
    b. Using a sufficiently sized front-end loader, grade the topsoil from top to bottom to create a continuous slope. The material should not collapse and/or segregate.
    c. Fill the bucket of the front-end loader by channeling the slope, beginning one (1) foot from the bottom, and continuing to the top of the slope in one operation.
    d. Transport the sample to the sampling location, lower the bucket to the ground level and slowly empty it by rotating the bucket to form a small pile.
3. Collect a sample from each small pile formed by Step 2 by following these steps:
    a. Divide the small pile visually into four equal quadrants.
    b. From the middle third of each quadrant, obtain a small shovelful of material.
    c. Place the four shovelfuls together in one approved granular materials sample bag or a container of sufficient size for thorough mixing.
    d. Mix thoroughly.
    e. Line a plastic quart container with a clear plastic bag and place enough of this topsoil mixture to completely fill the bag-lined container.
    f. Seal the plastic bag with a twist-tie.
    g. Seal the containers, including the bagged samples.
    h. Log all sample information into an Excel sheet. Include any "Remarks" as appropriate to indicate testing parameters (chose only from among those available - typically pH, organic matter (OM), texture and if needed, Nitrogen, Phosphorous and/or Potassium ("NPK") content).
    i. Print and affix a label identifying the sample to the outside of the container.

2.04 COMPOSTED ORGANIC MIX COMPONENT

A. Organic Component - Non-proprietary Requirements:

1. The organic amendment shall be stable, mature aerobically composted yard debris (green waste) compost. Leaf humus compost, manure compost, biosolids compost, peat, peat-humus, and mushroom compost products are not acceptable.

2. Compost Component Testing submittal results, per the Quality Assurance requirements shall meet the following characteristics:

   a. The compost shall have a man-made foreign material (hard plastics, metal, glass, etc.) content less than 1.5% as material retained on a U.S. Std.No.5 (4 mm) sieve (TMECC 03.06)

   b. The compost shall be screened such that a minimum of 90% passes a U.S. Std. 3/4" sieve and that no more than 10% passes a U.S. Std. No.10 sieve on a dry weight basis.

   c. The compost shall have a pH of 5.0 to 8.5 using USCC STA testing

   d. Compost shall have a soluble salts content, per USCC STA testing, of less than 6.0 dS/m.

   e. Compost shall have an organic matter content, per USCC STA testing, of not less than 30% by dry weight.

   f. The compost shall have a carbon to nitrogen (C:N) ratio less than 36:1.

   g. Compost shall have a stability index rating of Stable or Very Stable, per USCC STA testing.

   h. The compost shall be tested for nitrate nitrogen, phosphorus, potassium, calcium, magnesium, iron, manganese, zinc, copper, boron, and sodium using the SME-DTPA extraction method (NCR-221)

      1) The heavy metal content as determined by TMECC 04.06 shall not exceed the following limits:

Element	Concentration Limits (mg/Kg d.w.)
Arsenic	41
Cadmium	39
Chromium	1200
Copper	1500
Lead	300
Mercury	17
Molybdenum	50
Nickel	420
Selenium	36
Zinc	2800

   i. The compost shall meet all applicable state regulations based on the feedstock type.

j. All compost testing shall be done in conformance with the U.S. Compost Council's publication Test Methods for the Examination of Composting and Compost (TMECC) unless otherwise specified above.

PART 3 - EXECUTION

3.01 GENERAL

A. Section 31 22 19 – Finish Grading applies.

B. Provide approved Organic Compost at the locations indicated on the Contract Drawings per the Testing Agency recommendations.

1. To establish baseline Bid Quantities, provide 3-inch depth of approved organic compost to areas where existing soils have been ripped or tilled to 6-inch depth.

END OF SECTION

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SECTION 32 91 10

PROCESSED TOPSOIL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS / GENERAL REQUIREMENTS

A. Standard Processed Topsoil in this section may also be referred to as Processed Soil. Both are equal by definition.

B. This Section applies only to the manufacturing and delivery of the planting soil mix to the site. Refer to Section 32 20 19 – Finish Grading for subgrade preparation, placement, and final grading.

1.02 SUMMARY

A. Section Includes:

1. All labor, materials, equipment, and testing requirements necessary to provide and deliver to the site Processed Topsoil as specified herein, including but not necessarily limited to the following:

    a. Import soil from an authorized soil manufacturing facility or supplier.

2. Test, furnish and deliver Processed Soil, as shown on the drawings.

1.03 REFERENCES AND STANDARDS

A. The following references are used herein and shall mean:

1. ASTM: American Society of Testing Materials
2. NCR221: Recommended Soil Testing Procedures for the North Central Region
3. SSSA: Soil Science of America, Methods of Soil Analysis, Part 1 & Part 3
4. TMECC: Test Methods for the Examination of Composting and Compost
5. USDA: United States Department of Agriculture
6. USEPA: United States Environmental Protection Agency

B. Standard Specifications: Regional, State or Municipal Standard Specification Documentations for the location of proposed usage.

1.04 DEFINITIONS

A. Compost: An organic material that has been aerobically composted and stabilized from feedstocks such as green waste (yard debris), biosolids or other suitable organic materials.

B. Com-til: Composted biosolids material available from the City of Columbus specifically for the purpose of applying to and amending existing soils via a tilling operation. Com-til Plus material shall not be used.

C. Debris or Deleterious Materials: Elements including, but not limited to concrete, masonry, wood, excavated rock and rock fragments, rubble, overburden soils, abandoned utility structures, trash, refuse, and litter.

D. Finish Grade: Elevation of finished surface of a Soil System after specified compaction and natural settling.

E. Soil: A mineral soil from the A Horizon or B Horizon of a well-drained site and having a USDA soil texture classification of a Clay or Clay Loam and an organic matter content of not greater than 3% by weight as specified below.

F. Soil System: Exclusive to this technical specification section, a profile consisting of the native topsoil blended with approved amendments.

G. Subgrade: Surface or elevation of subsoil remaining after completing excavation or backfill of soils or other materials immediately beneath a planting mix or other Soil System.

H. Transition Layer: The specified soil mix (in this case = Std. Process Topsoil) is homogeneously blended into the existing native soil substrate to create a conversion layer between the native and specified soil mix. Transitions mixes and depths vary pending specified soil mix and plantings.

1.05 SUBMITTALS

A. Refer to and comply with specifications for submittal procedures and criteria.

B. Product Data: Submit technical descriptive data for each manufactured or packaged product of this Section. Include manufacturer's product testing and analysis and installation instructions for manufactured or processed items and materials.

1. Locations: Submit locations of material sources and suppliers.

C. Soil System Components and Soil Mix Suppliers

1. Landscape Architect shall have the right to reject any soil supplier.

2. Soil mix suppliers shall have a minimum of 5-years of experience at supplying “Manufactured” type soils.

3. Submit supplier name, address, email, telephone, and fax numbers and contact name.

4. Submit certification that accepted supplier can provide enough materials and mixes for the entire project and within the limitations of the Project Schedule.

D. Certificates: Submit certified analysis for each chemical soil amendment and fertilizer material specified (specimen label) and as used (product label). Including guaranteed analysis and weight for packaged materials.

E. Soil System Testing Submittals: Engage an independent testing agency to qualify Standard Processed Soil components and specified soil mixes. The Contractor shall submit representative

samples of all component materials which are intended to be used to make mixes and all final mixes to an agricultural soil testing laboratory acceptable to the Landscape Architect.

1. All soil tests shall be performed in accordance with the current methods provided by ASTM, SSSA or USEPA, unless otherwise noted. All reports prepared by the testing laboratory shall be sent to the Landscape Architect for approval. Samples of all soil materials to be brought to the site must be approved before delivery.
2. After reviewing the Testing Agency report and as directed by the Landscape Architect, deficiencies in the sand, organic materials, mix components or final soil mix are to be corrected by the Contractor.
3. Processed Soil Submittals:
    a. Date issued.
    b. Project Title and names of Contractor and supplier.
    c. Testing laboratory name, address and telephone number, and name(s), as applicable, of each field inspector or laboratory contact.
    d. Date, place, and time of sampling or test, with record of temperature and weather conditions.
    e. Location of material source.
    f. Type of test.
    g. Results of tests including identification of deviations from acceptable ranges.
    h. Soil pH and Buffer pH Test.
    i. Analysis for levels of heavy metals to include arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc. Test results shall be cited in milligrams per kilogram dry weight with comparisons to USEPA 40 CFR Table 3 of § 503.13 Pollutant Concentrations.
    j. Particle size analysis shall be performed and compared to the USDA Soil Classification System per ASTM D422 (hydrometer test). The USDA sand and gravel classifications shall be determined on material retained on the #270 sieve following a wet washing procedure.
    k. Deleterious materials shall be determined by ASTM D 5286.
    l. Percent of organic matter by weight shall be determined by ASTM D 2974 Method C, loss on ignition at 440oC.
    m. Saturated hydraulic conductivity shall be determined by ASTM F1815.
    n. Analysis for nutrient levels in parts per million or pound per acre including Nitrate Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Iron, Manganese, Zinc, Copper, Boron and Sodium as Exchangeable Sodium Percentage (ESP) per NCR221.
    o. Soluble salts shall be determined by electrical conductivity of a 1:2 soil/water slurry reported in millimhos per cm.

p. Cation Exchange Capacity (CEC) per NCR221 using the ammonium acetate method.

q. Soil analysis reports shall also show recommendations for soil additives, including organic and inorganic soil amendments, necessary to accomplish mix objectives noted.

F. Testing Agencies: The following firms are acceptable testing agencies for the various components.

1. Physical analysis on Sands, Soils and Soil Mixes shall be determined by an A2LA Accredited Lab, such as Turf Diagnostics and Design, 613 E. 1st Street, Linwood, KS, 66052, tel. 855-769-4231, www.turfdiag.com or other qualified soil physical testing laboratory approved by the Owner's Representative.

a. Spectrum Analytic, 1087 Jamison Rd. NW, Washington Court House, OH 43160-8748, tel. 800-321-1562 740-335-1562, www.spectrumanalytic.com.

2. Certified Local Agencies may be used pending approval by Owner's Representative.

3. Although the report(s) may contain the laboratory's comments or recommendations to the Owner's Representative regarding amendment requirements or procedures, the report shall not be interpreted as prescribing or dictating procedures or indicating quantities of soil materials for the work of this Contract.

4. Changing testing laboratories during the mix development phase or for quality assurance testing must be authorized by the Landscape Architect.

G. Statement(s) of Qualifications: Submit within 45 days of notice to proceed to confirm qualifications of the selected testing agencies.

H. Submit samples of Processed Soil to the Landscape Architect for approval:

1. Processed Soil, each source, 5 lb, packaged.

I. Equipment Data: Submit descriptive information with wheel load data for each proposed item of equipment to be used for execution of all earth work of this Contract. Equipment data will be evaluated for conformance to site use restrictions and mix compaction potential. All equipment used in mix placement shall have a ground pressure level of 4.5 psi or lower.

1. Large earth moving equipment (D4, D6 dozers) must have rubberized base tracks with low ground pressure.

2. Equipment with metal cleats will not be permitted.

J. Submit for approval at least two weeks prior to installation a written plan for transporting and storing materials.

1.06 QUALITY ASSURANCE

A. Processed Soil will not be accepted unless it meets all submittal, testing and certification requirements including the testing and certification reports in the format specified herein.

B. Inspections and Testing

1. Soil testing as required in this Section or additionally required by the Landscape Architect shall be furnished and paid for by the Contractor.
2. The Landscape Architect reserves the right to take and analyze at any time such additional samples of materials as deemed necessary for verification of conformance to specification requirements. The contractor shall furnish samples for this purpose upon request and shall perform testing as requested.
3. Samples that do not meet the Specifications will require the Contractor to re-submit additional samples for testing. Costs for re-testing will be the responsibility of the Contractor.
4. Observations and periodic testing will be made by the Owner or its designated representative on materials delivered to the site. Any Soil Mix that does not meet the requirements of the Specifications shall be removed or amended by the Contractor at no cost to the project.

C. Qualifications

1. Testing Laboratory: Experienced person (s) employed by public or private testing laboratory, qualified and capable of performing tests, making soil recommendations, and issuing reports as specified. The Testing Laboratory shall submit a Statement of Qualifications regarding the specified testing. The Testing Laboratory shall be as approved by the Landscape Architect.
2. It shall be the responsibility of the Contractor to see that the specifications are being adhered to. Failure of the Landscape Architect to immediately reject unsatisfactory workmanship or to notify the Contractor of his/her deviation from the specifications shall not relieve the Contractor of his/her responsibility to repair and/or replace unsatisfactory work.

D. Pre-Installation Conferences: Person(s) responsible for soil preparation and mixes of this Section shall attend Pre-Installation Conference(s) to coordinate with work of other sections.

1.07 PROJECT CONDITIONS

A. Investigate the conditions of site and public thoroughfares and roads as to availability, clearances, loads, limits, restrictions, and other limitations affecting transportation to, ingress and egress of this work site. Conform to all governmental regulations regarding the transportation of materials to, from, and at the job site, and secure in advance such permits as may be necessary.

B. Environmental Requirements for Soils and Soil System Mixes:

1. Perform both off-site mixing and on-site soil work only during suitable weather conditions. Do not work or process soil when frozen, excessively wet, or dry, or in otherwise unsatisfactory condition.
2. Soil Mixes shall not be handled, hauled, or transported during rain or wet weather.

3. When stockpiling is permitted, the Contractor shall install silt fence around the perimeter of the stockpile area and maintain the silt fence until the stockpile is removed. Processed soil shall be kept neat and separate piles from other excavated material.

C. Sequencing and Scheduling: Adjust, relate together and otherwise coordinate work of this Section with other Project work as contained in all other Sections of the Project Specifications.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver packaged materials to the location where soils are to be mixed, in unopened bags or containers, each bearing the name, guarantee, and trademark or the producer, material composition, manufacturer's certified analysis, and the weight or the material. Retain packages for the Landscape Architect.

B. Store and handle packaged materials in strict compliance with manufacturer's instructions and recommendations. Protect all materials from weather, damage, and theft.

C. Amendment materials stored on site temporarily in stockpiles prior to placement shall be protected from intrusion of contaminants and erosion. All temporary storage means, and methods shall be approved by the Landscape Architect.

D. Stockpiling

1. Stockpiling on-site, off-site, and at the source should be restricted to no more than the needs of what can be used in a 72-hr. period. Under no circumstances shall on-site or off-site stored material exceed 8000 cubic yards.

2. Stockpiles should be no more than 6 feet in height to prevent anaerobic conditions within the pile. Storage areas for topsoil shall be constructed on well drained land, away from standing or pooled water.

PART 2 - PRODUCTS

2.01 GENERAL

A. Existing soils, if present must be tested and found to be acceptable per the requirements of Section 32 91 00 Amend in Place, Part 2, Article: In-Field Testing of Stockpiled Soils.

B. Unless noted on the drawings, existing soils are not to be salvaged and used as Processed Soil without the Landscape Architects approval. Legally dispose of all excavated or stockpiled soils.

2.02 SOIL COMPONENTS

A. Base for Design: Kurtz Bros. – Processed Topsoil.

Kurtz Bros.
711 Frank Rd.
Columbus, OH 43223
614-491-0868

B. Processed Soil Requirements:

1. A clean, loamy, friable mineral soil free from heavy or stiff clay lumps (3/4'' max dia.), stones, cinders, concrete, brick, roots, sticks brush, litter, plastics, metals, refuse or other deleterious materials in accordance with ASTM D 5286-92.
2. The soil shall be free of herbicides, petroleum-based materials, manures, or other substances of a hazardous or toxic nature which may inhibit plant growth.
3. The soil shall be free of noxious weeds, seeds or vegetative parts of weedy plants that cannot be selectively controlled in the planting.
4. The soils shall be taken from the A Horizon or B Horizon of a well-drained site and have a USDA soil texture classification of a Clay Loam or Loam. The soil shall have the following particle size distribution:

U.S.D.A. Particle Name	Size (mm)	Allowable Limit
Gravel	2.00 – 4.75	Less than 5%
Sand	0.05 – 2.00	20 – 35%
Silt	0.002 – 0.05	25 – 45 %
Clay	minus 0.002	20 – 40%

5. Perform the following tests and submit test reports showing the following criteria are met:
   a. The particle size analysis as defined above.
   b. The pH shall be approx. 5.5 to 7.8 (NCR 221)
   c. The soluble salts shall be less than 1.5 mmoh/cm (NCR 221)
   d. The organic matter content shall be (ASTM D 2974 Method C):
      1) Organic Level for Turfgrass Areas: 3 to 5 percent
      2) Organic Level for Planting Areas: 6 to 8 percent
   e. Certified test results of bulk topsoil stored by certified suppliers must be within the last 12 months from the date of bid opening.
6. Provide certification from the supplier that the soil does not contain any toxic substances harmful to plant growth.

PART 3 - EXECUTION

3.01 GENERAL

A. Section 31 22 19 – Finish Grading applies.

END OF SECTION

CML BARNETT BRANCH LIBRARY ADDITION/RENOVATION

3434 East Livingston Avenue

Columbus, OH 43227

SECTION 32 92 00

TURF AND GRASSES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Seeding.
2. Turf renovation.
3. Maintenance

B. Related Requirements:

1. Section 31 20 19 “Finish Grading” for finish grading preparation.
2. Section 32 91 00 through 32 91 40 - Planting Prep and Soils for soil preparation.
3. Section 32 93 00 "Plants" for trees, shrubs, ground covers and other plants.

1.02 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Backfill: Soil material or controlled low-strength material used to fill an excavation.

C. Base Mix: Homogenously blended mix of the specified topsoil and the specified sand which is then used for mixing with the specified organic amendment to create various Planting Mixes.

D. Compost: An organic material that has been aerobically composted and stabilized from feedstocks such as a green waste (yard debris) or other suitable organic materials

E. Finish Grade: Elevation of finished surface of planting soil.

F. Manufactured Planting Soil Mix: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce a planting soil mix.

G. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

H. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

I. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. Soil preparations vary. See Sections 32 91 00 through 32 91 40 – Planting Prep and Soils for soil preparation and drawing designations for planting soils.

J. Sand: a naturally occurring material that has been processed to remove coarse gravel, silt and clay and sized to meet the specifications.

K. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

L. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

M. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site prior to beginning seedbed preparations. Construction Manager, Owner and Landscape Architect should be notified at least one week prior to the intended meeting date.

1.04 INFORMATIONAL SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

B. Product Certificates: For fertilizers, from manufacturer.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals, the Ohio Nursery and Landscape Association or the American Nursery and Landscape Association.

2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

3. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:

a. Landscape Industry Certified Technician - Exterior.

b. Landscape Industry Certified Lawn Care Manager.

c. Landscape Industry Certified Lawn Care Technician.

4. Pesticide Applicator: State licensed, commercial.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk materials with appropriate certificates.

1.08 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.

1. Spring Planting: April 1 to June 1.

2. Fall Planting: August 15 to October 1.

3. Delays in completion of planting operations which extend the planting and/or acceptance of Substantial Completion into the next planting season shall extend the Warranty period accordingly.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

C. Work notification: Notify the Landscape Architect at least seven working days before installation of lawn materials.

D. Verify location and extent of underground utilities. Protect existing utilities, irrigation, paving and other facilities from damage caused by lawn work operations.

E. Perform lawn work only after planting and other work affecting ground surface has been completed.

F. Restrict traffic from lawn areas until grass is established. Erect temporary signs and barriers as required by the Landscape Architect.

G. Locate, protect and maintain newly installed irrigation system during lawn work operations. Repair irrigation system components, damaged during lawn work operations, at Contractor's expense.

H. Provide necessary hose and watering equipment as required for lawn maintenance.

PART 2 - PRODUCTS

2.01 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality, State Certified: State-certified seed of grass species as listed below for solar exposure.

2. Quality, Non-State Certified: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed.

C. Turfgrass Seed Species: Turf-type tall fescue (90%) and Hybrid bluegrass (CV Thermal Blue)(10%).

2.02 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.03 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.04 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as

required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.03 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement, mix planting soil and finish grades according to Sections 32 91 00 – through 32 91 40 Planting Preparation specifications.

B. Placing Planting Soil: Place manufactured planting soil over exposed subgrade.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 APPLICATION OF FERTILIZER

A. Fertilizers and conditioners shall be applied at the following rates:

1. Fertilizer – Apply at rates according to soil analysis testing reports.

B. Mixing with planting soil:

1. Fertilizer and conditioners shall be spread over the entire lawn areas at the application rates indicated above.

2. Materials shall be uniformly and thoroughly mixed into the top 4” of topsoil by discing, rototilling, or other approved method.

3.05 SEEDING

A. Sow seeds with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

2. Do not use wet seed or seed that is moldy or otherwise damaged.

3. Do not seed against existing trees. Limit the extent of seed to the outside edge of planting saucer.

B. Sow seed at a total rate of 6 to 8 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft.. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

3.06 TURF RENOVATION

A. Renovate existing turf where indicated.

B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.

2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

1. Soil Amendment(s): Amend soil as per soil test results for specified turf grass soils. See applicable Sections 329100 through 329140 - Planting Prep and Soils for specified soil mix, testing, installation and preparation.

2. Initial Fertilizer: Commercial fertilizer or a Slow-release fertilizer applied according to manufacturer's recommendations.

J. Apply seed and protect with straw mulch or sod as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

3.07 TURF MAINTENANCE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: from date of planting completion until Substantial Completion/final acceptance.

a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

B. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

4. Treat infestation of weeds or crabgrass by hand weeding or herbicidal control. Furnish and install weed chemical control as recommended by manufacturer. Herbicidal controls, including renovation before seeding or sodding operations, shall be acceptable to the

Landscape Architect.

C. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

D. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow turf-type tall fescue to a height of 2 to 3 inches.

E. Turf Post-fertilization: Apply commercial fertilizer or a slow-release fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.08 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Landscape Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

C. Conditions: Established turf that is free of dead or dying patches and shows vigorous growth of foliage of normal density, size, and color.

3.09 OBSERVATION AND ACCEPTANCE

A. Beneficial Occupancy: the acknowledgement by the Owner and Landscape Architect that the landscape work defined by plans and specifications is substantially complete. The Landscape Architect shall provide the Contractor with a written punch list indicating items to be corrected or completed by the contractor within a two-week period from notification:

1. Site review is requested by the Contractor when he/she believes that the landscape installation meets all the requirements of the plans and specifications.

B. Final Acceptance: the date of final acceptance shall be when the Landscape Architect verifies that all the items on the punch list have been completed and / or corrected by the Contractor.

3.10 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION

CML BARNETT BRANCH LIBRARY ADDITION/RENOVATION

3434 East Livingston Avenue

Columbus, OH 43227

SECTION 32 93 00

PLANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plants including trees, shrubs, and groundcovers.
2. Tree stabilization.
3. Tree-watering devices.
4. Maintenance of all specified plants until the beginning of the warranty period.
5. Plant Warranty
6. Maintenance of all specified plants during warranty period.

B. Related Requirements:

1. Section 01 56 39 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 31 22 19 “Finish Grading” for finish grading preparation.
3. Section 32 91 00 through 32 91 40 - Planting Prep and Soils for soil preparation.
4. Section 32 92 00 "Turf and Grasses" for seeding and erosion-control materials.

1.02 REFERENCES

A. Federal, State and local laws and regulations governing this Work are hereby incorporated into and made part of this Section. When this Section calls for certain materials, workmanship, or a level of construction that exceeds the level of Federal, State, or local requirements, provisions of this Section take precedence.

B. American Society for Testing and Materials (ASTM).

1. ASTM D 1557- Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

C. American Nursery & Landscape Association (ANLA).

D. American National Standards Institute (ANSI)

1. ANSI Z60.1 – American Standards for Nursery Stock.
2. ANSI A300 Part 6 – Standard Practices for Tree, Shrub and other Woody Plant Management

1.03 DEFINITIONS

A. Acceptance, Acceptable, or Accepted: Acceptance by the Landscape Architect in writing.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation.

C. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the trunk flare / root crown visible at the surface of the ball as recommended by ANSI Z60.1.

D. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Debris or Deleterious Materials: Elements including, but not limited to concrete, masonry, wood, excavated rock and rock fragments, rubble, overburden soils, abandoned utility structures, trash, refuse and litter.

G. End of Warranty Final Acceptance: The date when the Landscape Architect accepts that the plants and work in this section meet all the requirements of the warranty. It is intended that the materials and workmanship warranty for Planting, Planting Soil, and Irrigation work run concurrent with each other.

H. Finish Grade: Elevation of finished surface of planting soil.

I. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

J. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

K. Planting Area: Areas to be planted.

L. Plant Spread: Measurement of main body diameter, not measurement from branch tip to branch tip.

M. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. Soil preparations vary. See Sections 32 91 00 through 32 91 40 – Planting Prep and Soils for soil preparation and drawing designations for planting soils.

1. Planting Soil Mix: A sand/soil/compost material produced off-site by homogeneously blending topsoil and sand with compost to produce the specified planting mix type.

2. “Planting Soil Mix” and “Planting Soil” are interchangeable terms used throughout this specification.

N. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

O. Root Flare (root collar, trunk flare, root crown): The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots, the area of transition between the root system and the stem or trunk.

P. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

Q. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

R. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

S. Substantial Completion Acceptance: The date at the end of the Planting, Planting Soil, and Irrigation installation where the Landscape Architect accepts that all work in these sections is complete, and the Warranty period (aka “Contractor’s Warranty Period”) has begun. This date may be different than the date of substantial completion for the other sections of the project.

T. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.04 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.

2. Plant Photographs: Include color photographs, (2) minimum per species, in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

3. Tree Selection Approvals:

a. All ornamental and shade trees are to be tagged in the field prior to digging. Tree tagging to be completed by the Contractor in conjunction with the Landscape Architect.

b. Acceptable trees will meet the following health and structure requirements: single dominate leader, branching and root structure appropriate for species, caliper size or height per plans, pest, and disease free, damage free and other ANSI requirements. Acceptable trees will also meet the following aesthetic requirements straight trunk, symmetry, uniformity and fullness of branching, general form, and overall uniformity of all trees of a species. No trees shall be delivered to the site without documentation.

B. Samples for Verification: For each of the following:

1. Organic Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

D. Close out submittals: Submit to the Landscape Architect for approval.

1. Plant maintenance data, requirements and recommended maintenance schedules and procedures for Owner to establish during the Warranty Period.

E. Warranty period site visit record: If the client assumes maintenance responsibilities during the warranty period per the specifications, the Contractor is to submit a written record to the Landscape Architect of his/her observations visits, citing any problems, potential problems, and any recommended corrective actions needed by the client. Refer to Part 3 for Maintenance responsibilities.

1.07 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over the Work.

B. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or the American Nursery and Landscape Association.

2. Experience: Five years' experience in landscape installation.

3. Submit reference list of at least five completed representative projects indicating project name, address, telephone number, contract amount, Landscape Architect's, and Facilities Manager's name.
4. Landscape Contractors submitting bids shall be pre-qualified before award of contract. Each reference shall be contacted to verify workmanship and general business practices.
5. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
6. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:
    a. Landscape Industry Certified Exterior Technician
    b. Landscape Industry Certified Horticulture Technician
    c. Landscape Industry Certified Lawn Care Technician
7. Pesticide Applicator: State licensed, commercial.

C. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

D. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure the main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

E. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

F. Plant Quantity Verification: All scaled dimensions on the drawings are approximate. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions and quantities and shall immediately inform the Landscape Architect of any discrepancies between the information on the drawings and the actual conditions, refraining from doing any work in said areas until given approval to do so by the Landscape Architect.

1. In the case of a discrepancy in the plant quantities between the plan drawings and the plant call outs, list or plant schedule, the number of plants or square footage of the planting bed drawn on the plan drawings shall be deemed correct and prevail.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Coordination."

1.08 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk materials with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

F. Handling Plants:

1. Handle ball and burlap plants by root ball.

2. Pad trunk and branches where hoisting cables or straps contact.

3. Handle container plants by containers, not by tops, stems or trunks.

4. Do not bind or handle plants with wire or rope.

G. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.

2. Do not remove container-grown stock from containers before time of planting.

3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.09 FIELD CONDITIONS

A. Work notification: Notify the Landscape Architect at least seven working days before installation of plant material.

B. All trees must be evaluated and approved by the Landscape Architect prior to planting.

C. Verify location and extent of underground utilities. Protect existing utilities, paving and other facilities from damage caused by landscaping operations.

D. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

E. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:

F. Install plant materials during time periods indicated. Planting operations conducted at other times only at option and full responsibility of Contractor and without additional compensation, except as otherwise acceptable to the Landscape Architect. Do not plant in frozen ground.

G. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 1 to June 1.

2. Fall Planting: September 1 to Nov. 15.

H. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

I. Coordination with Turf Areas: Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.10 ACCEPTANCE FOR SUBSTANTIAL COMPLETION

A. Substantial Completion Acceptance - Acceptance of the work prior to the start of the warranty period:

1. Once the Contractor completes the installation of all items in this section, the Landscape Architect will observe all work for Substantial Completion Acceptance upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of the observation.

2. Substantial Completion Acceptance by the Landscape Architect shall be for general conformance to specified size, character and quality and not relieve the Contractor of responsibility for full conformance to the contract documents, including correct species.
3. Any plants that are deemed defective as defined under the provisions below shall not be accepted.

B. The Landscape Architect will provide the Contractor with written acknowledgment of the date of Substantial Completion Acceptance and the beginning of the warranty period and plant maintenance period (if plant maintenance is included).

C. Acceptance in Part:

1. The work may be accepted in parts when it is deemed to be in the Owner's best interest to do so, and when permission is given to the Contractor in writing to complete the work in parts.
2. Acceptance and use of such areas by the Owner shall not waive any other provisions of this Contract.

1.11 WARRANTY

A. Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
        1) Inspection Reports and Maintenance Logs per “Closeout Submittals” apply.
    b. Structural failures including plantings falling or blowing over.
    c. Faulty performance of tree stabilization.
    d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Periods: From date of Substantial Completion unless noted otherwise.
    a. Trees, Shrubs, and Ornamental Grasses: 12 months.
    b. Ground Covers, Perennials, and Other Plants: 12 months.
3. When the work is accepted in parts, the warranty periods shall extend from each of the partial Substantial Completion Acceptances to the terminal date of the last warranty period. Thus, all warranty periods for each class of plant warranty shall terminate at one time.
4. Include the following remedial actions as a minimum:
    a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.

b. Replace plants that are more than 25 percent dead or in an unhealthy condition at the end of warranty period.

c. A limit of one replacement for each plant is required except for losses or replacements due to failure to comply with requirements.

d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

B. End of Warranty Final Acceptance - Acceptance of plants at the end of the warranty period.

1. At the end of the warranty period, the Landscape Architect shall observe all warranted work, upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date for final observation.

2. End of Warranty Final Acceptance will be given only when all the requirements of the work under this specification and in specification sections Planting Soil and Irrigation have been met.

PART 2 - PRODUCTS

2.01 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, sizes, grades, and ball or container sizes and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Growing Practices: Nursery grown in accordance with the best horticultural industry practices.

2. Nomenclature: Plant nomenclature shall meet requirements of ICBN and ICNCP.

3. Climatic Growing Conditions: Grown under climatic conditions (same USDA hardiness zone) of the like those of the project and within 150 miles of the project site for at least two years unless otherwise accepted by Landscape Architect.

4. Container Growth Limitations: Container stock shall have been grown in the containers in which delivered for at least six months, but not over two years.

5. Specimen Quality: Structurally strong, able to stand upright without stakes or guys, exceptionally heavy, symmetrical, tightly knit, so trained or favored in development and appearance as to be superior in form, number or branches, compactness, and symmetry.

6. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.

7. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

8. Pruning: Do not prune, thin, or shape plants before delivery without acceptance by the Landscape Architect.

B. Substitutions: Accepted substitute plants shall be true to species and variety and shall meet requirements of this Section except those plants larger than specified may be used, if accepted in writing by the Landscape Architect. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

1. Substitutions will only be accepted up to 60 days post bid submittal. The contractor is responsible for identifying the availability of materials and inform Landscape Architect of any stock shortages prior to the 60 day post bid submittal deadline.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

F. No tree wrap is to be used.

2.02 SHADE AND FLOWERING TREES

A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.

1. Provide balled and burlapped or container-grown trees.

2. Branching Height: One-third to one-half of tree height.

3. Street Trees: Street trees must be limbed to 8 feet minimum.

4. Forked Trunks on trees are not acceptable; each tree must have one string central leader.

B. Small Upright and Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:

1. Stem Form: Single stem.

2. Multi-Stem: Unless noted otherwise, tree shall have 3 -5 trunks forked at or above root flair collar. Overall height determines the size of tree.

3. Provide balled and burlapped trees.

4. Forked Trunks on trees are not acceptable; each tree must have one string central leader.

2.03 SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

1. Provide balled and burlapped or container-grown shrubs.

2.04 GROUND COVER / PERENNIAL

A. Ground Covers / Perennials: Provide ground cover of species indicated, established and well rooted in pots or similar containers and complying with ANSI Z60.1. Sections 1 and 13 apply.

2.05 FERTILIZERS

A. Refer to Soil Mix specifications test results and Final Grading for soil amendments.

B. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.

C. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

D. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended by manufacturer's written instructions.

E. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: (high phosphorus, low nitrogen ratio)

2.06 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Double shredded hardwood.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural, dark brown.

2.07 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.08 TREE-STABILIZATION MATERIALS

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Guying Material
    a. Arbortie: as manufactured by DeepRoot Green Infrastucture LLC.
        1) Or approved Equal.
    b. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes.

2.09 TREE-WATERING DEVICES

A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

2.10 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

B. Burlap: Non-synthetic, biodegradable.

2.11 SOURCE QUALITY CONTROL

A. Advanced Tree Procurement:

1. Within 60 days of award of contract, notify Landscape Architect in writing of the availability or lack thereof the specified plant material.
2. Procure trees and arrange for contract growing as required to ensure that plant material is available in the quantities, sizes, and quality specified at the time of installation.
3. Verify plant branching requirements with Landscape Architect prior to contract growing.
4. The Landscape Architect will review advance-procured trees prior to initial purchase at the place of growth.
5. Coordinate and schedule a review by the Landscape Architect of advanced procured plant material at the place of growth prior to delivery to the project site.
6. Review and acceptance of the advance-procured plant material at the place of growth does not preclude rejection at the project site if damage or unacceptable conditions are found that were not detected at the place of growth.
7. Before changes or substitutions can be considered due to unavailability of plant material, the contractor shall submit written evidence that he has advertised for at least a one-month period in a trade journal such as the "Landscape Materials Information Service", with no response, or has undertaken other methods of locating plant material acceptable to the Landscape Architect.

B. Plant Material Review and Tagging:

1. Trees will be reviewed, photographed, and tagged using irremovable tags by the Landscape Architect at the place of growth prior to delivery to the project site.
2. At the Landscape Architect's discretion, shrubs may or may not be reviewed, photographed, and tagged at the place of growth.
3. Tagging of plant material at the place of growth does not preclude rejection at the project site if damage or unacceptable conditions are found that were not detected at the place of growth or in submitted photographs.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
4. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
5. Uniformly moisten excessively dry soil that is not workable, or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.

C. Do not store materials or equipment or operate or park vehicles under the drip line of existing or newly planted trees. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

E. Lay out plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.03 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to the requirements of Planting Soil Mixes, Sections 32 91 00 through 32 91 40.

B. Placing Planting Soil: Place manufactured planting soil over exposed subgrade.

C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb the base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

2. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.

3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.

4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.

5. If the area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.

6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.

7. Maintain supervision of excavations during working hours.

8. Keep excavations covered or otherwise protected after working hours.

B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Test fill each tree and planting pit with water, prior to planting to assure proper soil percolation. Pits which do not adequately drain shall be further scarified along outer edges and sides of pit. Do not disturb the area supporting tree ball. Repeat test.

1. Notify Landscape Architect and Owner should 2nd fill test fail for additional input and corrective action.

2. No allowances shall be made for plant material loss due to improper drainage or if the contractor fails to perform fill test. The contractor shall replace lost plant material with same size and species at no additional cost to the owner.

E. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

F. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.05 TREE AND SHRUB PLANTING

A. General: Install plant material in accordance with detailed drawings and recommendations of ANLA.

B. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

C. Root Pruning:

1. If stem girdling roots are encountered at root ball sides, notify the Landscape Architect for field review.

2. Upon Landscape Architect's acceptance, remove stem girdling roots and kinked roots by cutting cleanly; do not break. Cut roots on 4 sides of root ball 90 degrees to root ball.

D. Root Ball Scarification:

1. After removing plant from container, scarify side of root ball to prevent root-bound condition.

2. Loosen root ball soil surface to depth of 1/8 inch to 1/4 inch without damaging roots or breaking root ball.

E. Balled and Burlapped Stock: Set each plant plumb and in center of planting bed or trench with root flare 2 inches above adjacent finish grades.

1. Backfill: Planting soil mix.

2. After placing some backfill around root ball to stabilize plant, carefully cut and remove upper 1/3 burlap (ANSI A300 – Part 6), rope, and wire baskets from tops of root balls and

from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When the planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Continue backfilling process. Water again after placing and tamping the final layer of soil.

F. Container-Grown Stock and Perennials in Containers: Set each plant plumb and in center of planting bed or trench.

1. Container Stock greater than 1 gallon container, place root flare 1-inch above finish grade.
2. Perennials or plant stock in 1 gallon and less containers, place top of root ball 1/2-inch above finish grade.
3. Backfill: Planting soil mix.
4. Carefully remove root ball from container without damaging root ball or plant.
5. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When the planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
6. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.06 TREE AND SHRUB PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.07 TREE STABILIZATION

A. Upright Staking Method: Stake trees of 2-inch through 3 1/2-inch caliper. Install trunk stabilization as follows unless otherwise indicated:

1. Install wood stake vertically as per detail driving stake minimum of 18 inches into grade.
2. Provide two stakes for trees up to 12 feet high and under 3-inches or less in caliper.
3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Refer to Manufacturer’s specifications for band height and general installation specifications.

B. Trunk Stabilization Method by Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings. Guy trees more than 12 feet in height and 3-inches and above in caliper unless otherwise indicated.

1. Site-Fabricated, Guying Method: Install minimum of three stakes and guys spaced equally around tree.

a. Install wooden stakes as per detail driving stake minimum 18 inches into subgrade. Adjust spacing to avoid penetrating root balls or root masses. Leave 18 inches of wood stake exposed above finish grade.

b. Support trees with bands of flexible ties providing loop around trunk of tree as recommended by manufacturers specifications. Refer to Manufacturer's specifications for band height and general installation specifications.

c. Attach flags to each flexible tie, 30 inches above finish grade.

3.08 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil mix for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.09 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 2-inch average thickness, with 18-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.

2. Organic Mulch in Planting Areas: Apply 2-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.10 EDGING INSTALLATION

A. Shovel-Cut Edging: Separate mulched areas from turf areas, curbs, and paving with a 45-degree, 4- to 6-inch-deep, shovel-cut edge.

3.11 INSTALLING SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.12 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting, and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices, when possible, to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.13 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.14 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Landscape Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition or are damaged during construction operations that Landscape Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of the same size as those being replaced.
2. Species of Replacement Trees: Same species being replaced.

3.15 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improper functioning devices.

3.16 PLANT MAINTENANCE PRIOR TO SUBSTANTIAL COMPLETION ACCEPTANCE

A. During the project work period and prior to Substantial Completion Acceptance, the Contractor shall maintain all plants.

B. Maintenance during the period prior to Substantial Completion Acceptance shall consist of pruning, watering, cultivating, weeding, mulching, removal of dead material, repairing and replacing of tree stakes, tightening and repairing of guys, repairing and replacing of damaged tree wrap material, resetting plants to proper grades and upright position, and furnishing and applying such sprays as are necessary to keep plantings reasonably free of damaging insects and disease, and in healthy condition. The threshold for applying insecticides and herbicide shall follow established Integrated Pest Management (IPM) procedures. Mulch areas shall be kept reasonably free of weeds and grass.

3.17 SUBSTANTIAL COMPLETION ACCEPTANCE

A. Upon written notice from the Contractor, the Owners Representative shall review the work and decide if the work is substantially complete.

1. Notification shall be at least 7 days prior to the date the contractor is requesting the review.

B. The date of substantial completion of the planting shall be the date when the Landscape Architect accepts that all work in Planting, Planting Soil, and Irrigation installation sections is complete.

C. The Plant Warranty period begins at the date of written notification of substantial completion from the Landscape Architect. The date of substantial completion may be different than the date of substantial completion for the other sections of the project.

3.18 MAINTENANCE DURING THE WARRANTY PERIOD (by Client / others)

A. After Substantial Completion Acceptance, the Contractor shall make sufficient site visits to observe the Owner's maintenance and become aware of problems with the maintenance in time to request changes, until the date of End of Warranty Final Acceptance.

1. Notify the Landscape Architect in writing if maintenance, including watering, is not sufficient to maintain plants in a healthy condition. Such notification must be made in a timely period so that the Landscape Architect may take corrective action.

a. Notification must define the maintenance needs and describe any corrective action required.

2. If the Contractor fails to visit the site and or notify, in writing, the Landscape Architect of maintenance needs, lack of maintenance shall not be used as grounds for voiding or modifying the provisions of the warranty.

3.19 END OF WARRANTY FINAL ACCEPTANCE / MAINTENANCE OBSERVATION

A. At the end of the Warranty and Maintenance period the Landscape Architect shall observe the work and establish that all provisions of the contract are complete, and the work is satisfactory.

1. If the work is satisfactory, the maintenance period will end on the date of the final observation.

2. If the work is deemed unsatisfactory, the maintenance period will continue at no additional expense to the Owner until the work has been completed, observed, and approved by the Landscape Architect.

B. FAILURE TO PASS OBSERVATION: If the work fails to pass final observation, any subsequent observations must be rescheduled as per above. The cost to the Owner for additional observations will be charged to the Contractor at the prevailing hourly rate of the Owners Representative.

END OF SECTION