

**DOCUMENT 00 73 00**  
**SUPPLEMENTARY CONDITIONS**

**1.1 RELATED REQUIREMENTS**

- A. AIA Document A104-2017 Standard Abbreviated Form of Agreement Between Owner and Contractor.
- B. Columbus Metropolitan Library, "Invitation to Bid (ITB)".

**1.2 GENERAL**

- A. The following supplements modify, delete from, or add to the Standard Abbreviated Form of Agreement Between Owner and Contractor referenced above.
- B. Where any provision of the Agreement is modified, unaltered provisions remain in effect.
- C. Sections of Division 01 – General Requirements govern the execution of the work of all sections of the specifications.

**1.3 SUPPLEMENTS**

- A. Article 2 – Date of Commencement and Substantial Completion
  - 1. Add to 2.1, Date of Commencement shall be established in a Notice to Proceed.
  - 2. Add to 2.3.1, The Contractor shall achieve Substantial Completion of the entire Work not later than \_\_\_\_\_ days from the date of commencement:
- B. Article 4 – Payment:
  - 1. Add to 4.1.1, Each Application for Payment shall be based upon the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of the values shall be prepared in such form and supported by such data to substantiate the accuracy as the Engineer or Owner may require. This schedule, unless objected to by the Engineer or Owner, shall be used as a basis for reviewing the Contractor's Application for Payment.
  - 2. Add to 4.1.2, "and shall indicate the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment, or as follows"
  - 3. Add to 4.1.4, Retainage of eight percent (8%) will be withheld on the cost of labor incorporated into the Work until the Work is 50 percent complete. When the Work is 50 percent complete, the payment for labor incorporated into the Work will be at the rate of 100 percent of the amount set forth in the Contractor's Application for Payment and approved by the Engineer. Retainage will be released upon Substantial Completion of the Work, minus any amount deemed necessary by the Owner or Engineer to assure full completion of the Work as well as delivery by Contractor to Owner record drawings and other items required pursuant to Section 15.7, and any warranties, instructions and maintenance manuals required to be furnished pursuant to Section 9.4, and a final statement of the cost of the Work allocated in accordance with the budget and in form and substance which has been approved the lender, if any, has been furnished.."
- C. Article 5 – Dispute Resolution
  - 1. Litigation in Court of Common Pleas for Franklin County, Ohio.
- D. Article 7 - General Provisions:
  - 1. Add to 7.2, The Contractor acknowledges and warrants that it has closely examined all the Contract Documents, that they are suitable and sufficient to enable the Contractor to complete

the Work in a timely manner for the Contract Sum and that they include all work, whether or not shown or described, which reasonably may be inferred to be required or useful for the completion of the Work in full compliance with all applicable codes, laws, ordinances, and regulations.

E. Article 8 - Owner:

1. Add to 8.1.2, Contractor acknowledges that any information other than the Contract Documents furnished by the Owner to the Contractor is for informational purposes only and does not constitute a representation by the Owner as to any of these items. Contractor acknowledges that any such information may be incomplete or inaccurate and that it has taken such additional steps as may be necessary to satisfy itself as to actual conditions. If Contractor encounters concealed conditions which differ materially from the conditions indicated in the Contract Documents and which could not have been reasonably discovered or foreseen from the Contractor's reasonable site investigation and its review of documents referred to above, the Contractor shall promptly inform the Owner and Engineer of the conditions and cooperate with them in determining how best to deal with the conditions; provided, however, that such concealed conditions shall constitute a ground for an increase in the Contract Sum or the Contract Time only as provided in Article 13.

F. Article 9 - Contractor:

1. Replace the following at 9.1.1, Execution of the Contract by the Contractor is a representation that the Contractor has (i) conducted a thorough investigation of the Site, the Contract Documents and other documents made available to the Contractor by the Owner, (ii) carefully investigated and considered the need to coordinate the Work with the work of other contractors, the possibility of delay in the various components of the Work, the possibility of obstacles and conditions not identified by the Owner (and the cost to the Contractor and impact on its schedule of such unidentified items), conditions relating to the transportation, handling and storage of materials, availability of labor, the effect of any labor agreements, weather, applicable provisions of law and the character and availability of equipment, material and facilities needed before and during the prosecution of the Work, (iii) reviewed all plans, specifications, drawings, reports and other materials with respect to the Project and its systems, (iv) considered staging, access and materials and equipment delivery issues, and evaluated all other matters and conditions of the Site which may affect the provision of Contractor's services and completion of the Contractor's Work. Contractor acknowledges that as a result of its inspections and other research with respect to the Site, except as otherwise provided in the Contract Documents, it assumes all risk of conditions to be encountered and the character, quality and quantities of services to be provided for the complete, timely and satisfactory performance of the Contractor's Work.
2. Add to 9.1.2, If the Contractor performs any construction activity knowing it involves a recognized error, inconsistency or omission in the Contract Documents without such notice to the Owner, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.
3. Add 9.1.4, 9.1.4 Concealed or Unknown Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that (i) differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents or (ii) which could not have been reasonably observed or inferred by the Contractor based on prior inspections, tests, reviews, information provided by the Owner or pre-construction services conducted by the Contractor, the Contractor shall promptly provide notice to the Owner and the Engineer before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Engineer will promptly investigate such conditions and, if the Engineer determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Engineer determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Engineer shall promptly notify the Owner and Contractor in writing, stating the reasons. If either party disputes the Engineer's determination or recommendation, that party may proceed

as provided in Article 21.

4. Add to 9.2.1, In no event shall the Owner have control over, charge of, or any responsibility for construction means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.
  5. Add 9.3.4, PREVAILING WAGES, §9.3.4 The Contractor is required to, and shall pay wages not less than, prevailing wages for the geographic area of this Project as established by the Ohio Department of Commerce, Wage and Hour Bureau and as required by the provisions of Ohio law and as further set forth in the Specifications.
  6. Add to 9.4, . Any defects which arise from a breach of the foregoing warranties, or any other warranties provided by Contractor, its subcontractors or material suppliers, shall be corrected in accordance with Article 18. The Contractor shall, upon final completion of the Work, assign to the Owner all warranties obtained or obtainable by the Contractor from manufacturers and suppliers of equipment and materials incorporated into the Work by written instrument of assignment in a form acceptable to the Owner. The Contractor shall perform the Work in such manner as to preserve all manufacturer's warranties.
  7. Add to 9.5, Materials purchased for use or consumption with the Work will be exempt from the State of Ohio Sales Tax as provided for in Section 5739.02 of the Revised Code of Ohio and also from the State of Ohio Use Tax, Section 5741.01.
  8. Add 9.9.3, The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Engineer.
- G. Article 10 - ENGINEER:
1. Change "Architect" to "Engineer" throughout this document.
- H. Article 11 - Subcontractors
1. Add to 11.1, The term Subcontractor shall also include persons supplying materials and equipment incorporated into, or consumed by, the Work.
  2. Add 11.4: Notwithstanding any of the foregoing provisions of Article 11.1, Contractor hereby certifies that any part of the Work performed for Contractor by a Subcontractor shall be pursuant to a written subcontract between the Contractor and such Subcontractor. Each such Subcontract shall, where the context so requires, contain provisions that:
    - .1 waive all rights the contracting parties may have against one another or that the Subcontractor may have against the Owner for damages caused by fire or other perils covered the insurance described in the Contract Documents;
    - .2 require the Subcontractor to carry and maintain insurance coverage in accordance with the Contract Documents or such lower coverage as Owner may approve, and to file certificates of such coverage with the Contractor;
    - .3 require the Subcontractor to submit certificates and conditional waivers of lien for work completed by its and by its Subcontractors and materialmen and unconditional waivers of lien for work previously paid for, as a condition to the disbursement of the progress payment next due and owing;
    - .4 report, so far as practicable, unit prices and any other feasible formula for use in the determination of costs and changes in the Work;
    - .5 require each Subcontractor to furnish to the Contractor in a timely fashion all information necessary to assist the Contractor in meeting its obligation pursuant to this Agreement; and
    - .6 require that each Subcontractor continue to perform under its Subcontract in the event the Contract is terminated and the Owner shall take an assignment of said Subcontract and request such Subcontractor to continue such performance consistent with this Agreement.
- I. Article 13 – Changes in the Work
- a. Add to 13.1, The Contractor shall proportionately increase the amount of its bond whenever the Contract Sum is increased. A Change Order signed by the Contractor without any

indication of change in the Contract Time indicates the Contractor's agreement that there will be no change in Contract Time.

- b. Add to 13.2, Any Change Order which adjusts the Contract Sum shall contain a breakdown of the adjustment between overhead, profit, labor, equipment and materials, together with substantiating data, as provided to the Engineer by the Contractor. Agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and all adjustments to the Contract Sum and the Contract Time.

J. Article 14 – Time

- a. Add to 14.5, If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Engineer, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control; or by other causes that the Engineer determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Engineer may determine. Contractor must provide written notice to the Owner of such delays as required in Article 21. The failure to give such notice will constitute an irrevocable waiver of the Contractor's right to seek an extension for such delay. The only delays for which the Contractor will be entitled to an extension of the time for completion will be delays caused by (i) physical damage to the Project over which the Contractor has no control; (ii) unusually severe weather conditions not reasonably anticipatable (temperature, rain, or other precipitation within a range of twenty percent of normal amounts for the time of the year shall not be considered unusually severe weather conditions); and (iii) the proximate result of the Owner's act or failure to act. Contractor shall not be entitled to damages from the Owner for delays caused by another contractor.
- b. Add 14.6, If the Contractor shall fail, neglect, and/ or refuse to complete the Work within the provisions of the approved construction schedule or by the Substantial Completion date, or it is determined that Contractor's delays directly delay Substantial Completion or any Project milestone requirement, Contractor shall be subject to liquidated damages (not a penalty) at the rate set forth below per calendar day for the total number of days the Work or milestone requirement is delayed beyond the Substantial Completion date:

LIQUIDATED DAMAGES

Contract Amount	Dollars Per Day
\$1.00 to \$100,000.00	\$250.00
\$100,000.01 to \$500,000.00	\$500.00
\$500,000.01 to \$2,000,000.00	\$1,000.00
\$2,000,000.01 to \$5,000,000.00	\$2,000.00
\$5,000,000.01 to \$10,000,000.00	\$2,500.00
\$10,000,000.01 or more	\$3,000.00

K. Article 15 – Payments and Completion

- 1. Add to 15.3.1, Contractor will submit with each Application for Payment the following: (a) lien waivers from each subcontractor, sub-subcontractor and material supplier to be paid from the current draw, which lien waivers will cover all Work executed by such parties through the end of the month immediately preceding the month covered by the current Application for Payment (or conditional lien waivers for all Work through the end of the month for which disbursement is being requested), (b) a current list of the subcontractors involved in the Work, (c) if requested by Owner, supporting data including invoices from subcontractors and suppliers and (d) copies of all notices of intent to file a lien served on Contractor prior to the date of such Application for Payment. In addition, in connection with Contractor's final Application for Payment, Contractor will submit final, unconditional lien waivers from all subcontractors, sub-subcontractors and material suppliers involved in the Work and which furnished labor or materials with a value of \$5,000 or more, together with such other documentation as Owner may require (such as paid

invoices) to evidence that the entire Work has been paid for.

2. Add 15.4.1, If the Contractor disputes any determination by the Engineer or the Owner with regard to any Certificate for Payment, the Contractor shall nevertheless expeditiously continue to prosecute the Work, provided Contractor has been paid in full for the undisputed amounts due and owing in accordance with the payment schedule set forth in the Contract Documents. If the Engineer declines to certify payment and withholds its Certificate for Payment for any reason, the Engineer shall promptly notify the Owner in writing of such reasons therefore.

L. Article 17 – Insurance and Bonds:

1. Add 17.3.2, The Contractor shall furnish bonds as required by Ohio Revised Code Section 153.54 in the form required by Ohio Revised Code Sections 153.57 and 153.571 and as further required by the Invitation to Bid.

M. Article 21 Claims and Disputes

1. Delete Paragraph 21.5
2. Delete Paragraph 21.6
3. Delete Paragraph 21.7
4. Delete Paragraph 21.8
5. Delete Paragraph 21.9

**END OF DOCUMENT**

**SECTION 00 73 43**  
**PREVAILING WAGE RATES**

**PAYMENT OF PREVAILING WAGE RATES**

1. The Contractor shall pay the prevailing wage rates of the Project locality, as issued by the Ohio Department of Commerce, Wage & Hour Bureau, to laborers and mechanics performing Work on the Project.
2. The Contractor shall comply with the provisions, duties, obligations, and is subject to the remedies and penalties of ORC Chapter 4115.
3. If the Contractor or its Subcontractors fail to comply with ORC Chapter 4115, the Contracting Authority may withhold payment. The Contractor is liable for violations committed by the Contractor or its Subcontractors to the extent provided in ORC Chapter 4115.
4. The Contractor shall submit all payroll reports in compliance with the requirements of Section “PREVAILING WAGE RATE REVISIONS” for all of the employees of the Contractor and of the Contractor’s Subcontractors.
5. By executing a Contract, the Contractor certifies that it based its Bid upon the prevailing rates of wages as ascertained by the Ohio Department of Commerce, Wage and Hour Bureau for the Project as provided in ORC Sections 4115.03 through 4115.14

**PREVAILING WAGE RATE REVISIONS**

- 1 The Contracting Authority shall, within 7 business days after receipt of a notice of a change in the prevailing wage rates, notify the Contractor of the change. The prevailing wage rates are available at the Ohio Department of Commerce’s web site: <http://com.state.oh.us/>
2. The Contractor shall pay any revised wage rates issued during the term of the Contract.

**PAYROLL SCHEDULE**

1. Within 10 days of the date of the Notice to Proceed, the Contractor shall provide the Contracting Authority’s Prevailing Wage Coordinator a schedule of dates during the term of the Contract on which wages shall be paid to employees for the Project.

**PAYROLL REPORTS**

1. The Contractor shall submit payroll reports with each Contractor Payment Request, which reports shall be certified by the Contractor that the payroll is correct and complete and the wage rates shown are not less than those required by the Contract. The Contractor is responsible for submitting all payroll reports of its Subcontractors.
  - 1.1 Each payroll report shall indicate the period covered and include a list containing the name, address and social security number of each employee of the Contractor and its Subcontractors paid for the Work.
  - 1.2 Each payroll report shall list the number of hours each employee worked each day on the Project during the reporting period, the total hours each week on the Project, the employee’s hourly rate of pay, job classification, hourly rate of fringe benefits, and all deductions from wages and net pay.
  - 1.3 Each payroll report shall list each fringe benefit and state if it is paid as cash to the employee or to a named plan.
  - 1.4 The Contractor and its Subcontractors shall submit apprenticeship agreements for all apprentices utilized on the Project with the first payroll report from the Contractor or its Subcontractor that includes apprentices.

**END OF SECTION**

**SECTION 01 11 00**  
**SUMMARY OF WORK**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Overview of the work of the project including parameters of the work of the contract and including administrative requirements.

**1.02 WORK OF THE CONTRACT DOCUMENTS AND PROJECT DESCRIPTION**

- A. The Project is entitled: **Columbus Metropolitan Library: Main Library Air Handling Unit Replacement.**
- B. The project location is:  
96 South Grant Avenue  
Columbus, OH 43215
- C. The Engineer is:  
**KORDA/NEMETH ENGINEERING, INC.**  
1650 Watermark Drive, Suite 200  
Columbus, Ohio 43215-7010
- D. The CONTRACT DOCUMENTS for the Project were prepared by the Engineer. Contract Documents are dated October 28, 2022.

**1.03 SUMMARY OF CONTRACT WORK**

- A. Refer to ITB for project description and scope.

**1.04 CONTRACT DOCUMENTS**

- A. The Contract Documents are defined in the “Definitions” section of the Contract Requirements.
- B. Project Work shall be executed in accordance with the Contract Documents. Provide all items, articles, materials, equipment, operations or methods listed, required to be provided by reason of the drawings or any part of the other Contract Documents, including all labor, materials, equipment and incidentals required or necessary for completion within the time specified in the Contract Documents.
- C. The Contractor and sub-contractors are responsible for careful examination of all of the Contract Documents to ascertain the full extent of the work under their contract. Work installed under the Contract that must be changed, and which could have been avoided by the foregoing reference, shall be changed and paid for by the contractor.

**1.05 CONTRACTORS USE OF SITE**

- A. Refer to ITB for requirements.

**1.06 SPECIFICATION FORMATS AND CONVENTIONS**

- A. Specification Format: The Specifications are organized into Divisions and Sections using the new **MASTERFORMAT™ 2020 Edition** numbering system.
  - 1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; based on the types of work required for this project. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
  - 2. The complete **MASTERFORMAT™ 2020 Edition** is available on-line at <http://www.masterformat.com>

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- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
  2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
    - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

**PART 2 – PRODUCTS**

Not Used

**PART 3 – EXECUTION**

Not Used

**END OF SECTION**



**SECTION 01 26 00**  
**CONTRACT MODIFICATION PROCEDURES**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- 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.
  - 2. Section 01 60 00 – Product Requirements: Equipment for administrative procedures for handling requests for substitutions made after Contract award.

**1.02 MINOR CHANGES IN THE WORK**

- A. Engineer will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

**1.03 PROPOSAL REQUESTS**

- A. Owner-Initiated Proposal Requests: Engineer 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. Bulletins issued by Engineer are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time or on date specified in the 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. 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.
    - c. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - 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.
- B. Contractor-Initiated Requests for Information: Requests by the Contractor for additional information which may result in changes to the work shall be in writing in a form prepared or approved by the Engineer, and shall include a detailed written statement that indicates the specific drawings of specifications in need of clarification and the nature of the clarification requested.
  - 1. Requests for information shall be for the purpose of facilitating construction.
  - 2. Requests for information shall be reported promptly to the Engineer.
  - 3. Clarifications of the Engineer resulting in changes in the work will follow the procedure for "Owner Initiated Proposal Requests" in this specifications section.

**1.04 CHANGE ORDER PROCEDURES**

- A. On Owner's approval of a Request for Proposal, Engineer will issue a Change Order for signatures of Owner and Contractor on standard form.

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**1.05 CONSTRUCTION CHANGE DIRECTIVE**

- A. Construction Change Directive: Engineer may issue a Construction Change Directive on AIA Document G714. 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 Engineer's office.

**1.06 FIELD AUTHORIZATION**

- A. Field Authorization: Owner or Engineer may issue a Field Authorization on form provided by Owner. Field Authorization instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Field Authorization 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 Field Authorization.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

**PART 2 – PRODUCTS**

Not Used

**PART 3 – EXECUTION**

Not Used

**END OF SECTION**

**SECTION 01 26 13**  
**REQUESTS FOR INTERPRETATION**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Administrative and procedural requirements for handling and processing Requests For Interpretation.

**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 Interpretation (RFI): A request for information by the Contractor to the Engineer 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 Interpretation:
  - 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 INTERPRETATION (RFI'S) DURING CONSTRUCTION**

- A. RFI's are logged-in at the Engineer'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 Engineer.
  - 1. RFI's sent by the Contractor and received on a Friday after 2:00 PM are to be dated the following Monday, holidays excepted.
- B. Requests for Interpretation (RFI): If clarification of any portion of Construction Documents is required, submit a Request for Interpretation to the Engineer in accordance with the following procedures:
  - 1. RFI Format:
    - a. Submit in electronic format on a standard form developed by the Contractor.
    - b. RFI's shall be sequentially numbered; and include the following:
      - 1) Project name.
      - 2) Project number.
      - 3) Date.
      - 4) Name of Contractor.
      - 5) Name of Engineer.
      - 6) RFI number, numbered sequentially.
      - 7) RFI subject.
      - 8) Specification Section number and title and related paragraphs, as appropriate.
      - 9) Drawing number and detail references, as appropriate.
      - 10) Field dimensions and conditions, as appropriate.
      - 11) Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
      - 12) Contractor's signature.
      - 13) Adequate space for Engineer to respond, sign, and date.
      - 14) Attachments: Include sketches, descriptions, measurements, photos, Product Data, and other information necessary to fully describe items needing interpretation.
        - 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.

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- C. Contractor shall submit a copy of the format to the Engineer and Owner's Representative at start of Project for review and comment.
- D. RFI Inquiry:
  - 1. Clearly state and completely define the issue requiring interpretation. Provide drawing and detail numbers, specification section numbers and paragraphs, sketches and other reference information.
  - 2. Provide potential solutions to issues when possible.
  - 3. Provide cost and schedule implications, if any.
  - 4. Ambiguous RFI's will be returned to Contractor without action taken.
- E. RFI Submission Process:
  - 1. The Contractor shall submit an RFI, in writing, to Engineer immediately with a copy to the Owner's Representative when any issue requiring clarification arises.
    - a. Unless specifically stated on RFI, the Engineer and the Owner will assume adjustments to the Contract Amount and the Project Schedule are NOT REQUIRED.
  - 2. The Engineer will review and respond only to RFI's received in writing from the Contractor.
  - 3. Allow seven (7) days for the Engineer to review and respond to the RFI.
  - 4. RFI's submitted to the Engineer without following these submission procedures will result in rejection of the submission.
- F. RFI Log:
  - 1. Contractor shall maintain an RFI log indicating the RFI number, subject, date, response date and impact, if any on schedule and cost.
  - 2. Contractor shall publish the log at least bi-monthly to the Engineer and Owner's Representative.

**PART 2 – PRODUCTS**

Not Used

**PART 3 – EXECUTION**

Not Used

**END OF SECTION**

**SECTION 01 31 00**  
**PROJECT COORDINATION**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to the following:
  - 1. General project coordination procedures.
  - 2. Progress meetings.
  - 3. Administrative and supervisory personnel.
  - 4. Pre-installation conferences.
  - 5. General installation provisions.
  - 6. Construction photographs
  - 7. Cleaning and protection.
- B. 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.
  - 2. Section 01 33 00 – Submittal Procedures: Contractor's Construction Schedule.
  - 3. Section 01 60 00 – Product Requirements: Coordinating general installation.
  - 4. Section 01 77 00 – Closeout Procedures: Coordinating construction closeout.

**1.02 COORDINATION**

- A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, which 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 accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. 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 and separate contractors if coordination of their Work is required.
- C. 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. Project closeout activities.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

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**1.03 SUBMITTALS**

- A. Photographic Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
  - 1. Identification: Provide the following information with each image description in file metadata tag:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of Engineer.
    - d. Name of Contractor.
    - e. Date photograph was taken.
    - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    - g. Unique sequential identifier keyed to accompanying key plan.

**1.04 ADMINISTRATIVE AND SUPERVISORY PERSONNEL**

- A. The Contractor shall provide a full-time, on-site General Superintendent whenever any project work is being performed at the site. Superintendent shall be experienced in administration and supervision of construction and construction personnel.
  - 1. This Contractor is hereby authorized to act as the general coordinator of interfaces between the work of the contractor and the work of subcontractors, if any.
  - 2. For the purpose of this provision, "interface" is defined to include access to, scheduling and sequencing of work, sharing of access to work spaces, installations, protection of each other's work, cutting and patching, tolerances, cleaning, inspections, tests, and temporary facilities and services.
- B. Staff Names: Within 15 days of award of contract and prior to starting work on site, submit a list of principal staff 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, job, Nextel and office telephone numbers. 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 temporary field office, and by each temporary telephone.
- C. Coordination Meetings: Unless otherwise specified in the Contract Documents, the Contractor shall prepare a written report of each coordination meeting and distribute the report within three (3) business days of the meeting to the Engineer, the Owner, the Contractors and any other Coordination Participants. The Contractor shall not delegate the duty to prepare a written report of each coordination meeting.

**1.05 PROJECT COORDINATION**

- A. Coordinate work of subcontractors including that related to:
  - 1. Temporary facilities and controls.
  - 2. Work specified in Divisions 02 through 49 of the specifications.
- B. Coordinate schedules of subcontractors and material suppliers to:
  - 1. Verify timely deliveries and materials and products for installation by other subcontractors.
  - 2. Verify labor and materials are adequate to maintain schedules.
- C. Conduct conferences with subcontractors and other concerned parties as necessary to:
  - 1. Maintain coordination and schedules.
  - 2. Resolve matters in dispute.
- D. Participate in project meetings to ensure coordination and to:
  - 1. Report on progress of work.
  - 2. Recommend needed changes in schedules.

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- E. Coordinate temporary facilities and controls as required to:
  - 1. Verify installation, operation and maintenance complies with governing codes and regulations.
  - 2. Verify adequacy of facilities and controls for construction activities and operations.
- F. Coordinate shop drawings, product data and submittals. Review for compliance with requirements of Contract Documents prior to submittal.
  - 1. Verify field dimensions and clearances.
  - 2. Verify relation to available space.
  - 3. Verify settings of anchorages including anchor bolts.
  - 4. Review effects of changes in work with subcontracts and other contracts.
  - 5. Verify compatibility of equipment with work of other subcontracts.
  - 6. Verify motor voltages and control characteristics.
  - 7. Coordinate controls and interlocks to verify voltages and phase, and wiring of pneumatic electric switches and relays.
- G. Prepare coordination drawings as required to assure coordination of work and to resolve conflicts prior to installation.
- H. Observe required testing, maintain records of tests and record:
  - 1. Testing agency and name of inspector.
  - 2. Subcontract work being tested.
  - 3. Representatives present.
  - 4. Date and time of testing.
  - 5. Type of products or work being tested.
  - 6. Types of tests and results.
  - 7. Any retesting required.
- I. Verify subcontractors are maintaining accurate project record documents.
- J. Review proposals and requests for substitutions, modifications and changes.
  - 1. Verify compliance with requirements.
  - 2. Verify compatibility with work and equipment of other subcontracts.
  - 3. Recommend action.
- K. Verify work complies with requirements of Contract Documents.
  - 1. Maintain record of observed deficiencies and discrepancies.
  - 2. Promptly report deficiencies and discrepancies to Engineer.
- L. Assemble documentation associated with any claims or disputes.
- M. Attend equipment start-up:
  - 1. Verify services and connections are complete and equipment is in operable condition.
  - 2. Observe testing, adjusting and balancing.
  - 3. Record results including time and date of start-up.
- N. Coordinate inspection and acceptance of equipment.
  - 1. Prior to inspection, verify equipment is clean, tested and operational.
  - 2. Assist inspector and prepare list of items to be completed or corrected.
  - 3. Should acceptance and operation of equipment constitute the beginning of any specified guarantee period, prepare and transmit written notice.
- O. Coordinate inspection and acceptance of work.
  - 1. Prior to inspection verify work is complete and ready for acceptance.
  - 2. Assist inspector and prepare list of items to be completed or corrected.
  - 3. Should acceptance of work constitute the beginning of any specified guarantee period, prepare and transmit written notice.
- P. Assemble project record documents.
- Q. Submit copies of lists, tests and operating logs to Engineer.

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**1.06 PROJECT MEETINGS**

- A. The Contractor shall schedule and conduct meetings, take meeting minutes, and conducting conferences at Project site.
- B. Progress Meetings: Conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
  - 1. Attendees: In addition to representatives of the Engineer, 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 conference 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. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether contract is on time, ahead of schedule, or behind schedule, in relation to Contractor'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. 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 report of each meeting.
    - c. Agenda: 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) Change Orders.
      - 12) Status of correction of deficient items
      - 13) Filed observations
      - 14) Status of RFI's
      - 15) Status of proposal requests.
      - 16) Pending changes.
      - 17) Status of Change Orders.
      - 18) Pending claims and disputes.
      - 19) Documentation of information for payment requests.
- C. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Engineer, but no later than 15 days after execution of the Agreement.
  - 1. Attendees: Engineer, 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.



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- g. Procedures for testing and inspecting.
  - h. Procedures for processing Applications for Payment.
  - i. Distribution of the Contract Documents.
  - j. Submittal procedures.
  - k. Preparation of record documents.
  - l. Use of the premises
  - m. Work restrictions.
  - n. Working hours.
  - o. Owner's occupancy requirements.
  - p. Responsibility for temporary facilities and controls.
  - q. Procedures for moisture and mold control.
  - r. Procedures for disruptions and shutdowns.
  - s. Construction waste management and recycling.
  - t. Parking availability.
  - u. Office, work, and storage areas.
  - v. Equipment deliveries and priorities.
  - w. First aid.
  - x. Security.
  - y. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute 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.

**PART 2 – PRODUCTS**

**2.01 PHOTOGRAPHIC MEDIA**

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

**PART 3 – EXECUTION**

**3.01 DIGITAL PHOTOGRAPHY**

- A. Provide digital camera photos throughout the project as required by these specifications and/or requested by Owner. Contractor shall take multiple digital camera photos of the following to be submitted electronically, via e-mail to the Engineer. **Cell phone photos are not acceptable.**
- B. Contractor shall take and submit digital camera photos' of the various difficult watertight locations and mechanical fastening that will be hidden from view or otherwise concealed beneath the completed work. Multiple photos shall be taken of the entire installation starting at the roof deck and continuing throughout the roof system installation as it progresses in layers, as required per specification
- C. Contractor shall take and submit digital camera photos of all changes to the scope of work to include existing conditions as the work takes place in its various stages of demolition and of the new Work as it takes place throughout its various stages.
- D. Provide digital camera photos of the completed work. Photos shall include the various metal flashing details, transitions and penetration height changes and in general an over-all view of the field of all roof areas. Photos shall be identified by the roof area where photos are taken.

**3.02 GENERAL INSTALLATION PROVISIONS**

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

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- B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
- C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
- D. Provide attachment and connection devices and methods necessary for securing Work. Secure work true to line and level. Allow for expansion and building movement.
- E. Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Engineer for final decision.
- F. Recheck measurements and dimensions, before starting each installation.
- G. Install each component during weather conditions and project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- H. Coordinate temporary enclosures within required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
- I. Where mounting heights are not indicated, verify mounting height requirements with the Engineer for final decision.

**3.03 CLEANING AND PROTECTION – GENERAL**

- A. Clean and protect construction in progress and adjoining materials in place during handling and installation. Apply protective covering where required to assure protection from damage or deterioration until Substantial Completion.
- B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- C. 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 construction period.

**END OF SECTION**

**SECTION 01 33 00**  
**SUBMITTAL PROCEDURES**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Administrative and procedural requirements for submittals required for performance of the Work including: contractor's construction schedule, schedule of values, product list, shop drawings, product data, samples, manufacturer's instructions and manufacturer's certificates.
- B. Related Sections:
  - 1. Refer to other Division 01 sections and other Contract Documents for specifications on administrative, non-work related submittals. Such submittals include, but are not limited to the following items:
    - a. Contractors Construction Schedule.
    - b. List of Subcontractors.
    - c. Schedule of Values.
    - d. Schedule of Materials and Equipment.
    - e. Certificate of Insurance and Worker's Compensation Certificate.
    - f. Application for payment.
    - g. Permits.
    - h. Inspection certificates and test reports.
    - i. Items required to be submitted prior to final payment and release of retainage.
  - 2. Section 01 77 00 – Closeout Procedures: Requirements for closeout submittals.

**1.02 SUBMITTAL REQUIREMENTS**

- 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 re-submittals.
- B. 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 Engineer 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 Engineer sufficiently in advance of the Work to permit processing.
- C. Prepare each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the Engineer using an electronic transmittal form. The Engineer will not accept submittals receive from sources other than the Contractor.
- D. Large Format Submittals: Submit 1 print and 1 electronic copy (.pdf format) of each shop drawings, including fabrication, erection, layout and setting drawings and such other drawings as required under various sections of the Specifications, until final acceptance is obtained. Prepare drawings legibly, drawing plans, elevations, sections and details in scales required on drawing sheets not larger than 30" X 42" nor smaller than 24" X 30".
  - 1. Engineer will review shop drawings and return electronic copy to the Contractor.
- E. Small Format Submittals (8-1/2" X 11" or 11" X 17"): Submit electronic copies (.pdf format) of manufacturer's descriptive product data including catalog sheets for materials, equipment and fixtures, showing dimensions, performance characteristics and capacities, wiring diagrams and controls, schedules, and other pertinent information as required. Where materials describe more than one product or model, clearly identify which is to be furnished.
- F. Submit samples cured and finished and identical to product proposed for use. Include generic description, source product name and manufacturer, and compliance with requirements. Submit samples for kind, color, pattern, and texture for comparison to actual units delivered and installed.

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**1.03 SUBMITTAL PROCEDURES**

- A. Each copy of each submittal shall have a cover sheet firmly attached. The cover sheet does not replace the required use of transmittals. The Engineer will furnish each Contractor a reducible blank cover sheet. Provide the following information on the Cover Sheet.
1. Project title and number including date or revision date. Allow space for contractor's and Engineer's stamps.
  2. Submittal number. Number submittals consecutively. If re-submittals are necessary, include the suffix A, B, C, etc. (For example, Submittal 17A would represent a re-submittal of Submittal 17).
  3. Specification Section, Article, Paragraph and further identification if necessary to the specific location of the submittal requested in the specifications.
  4. Listing of items being submitted. (For example, Interior Lighting Fixtures C, D, M, and T).
  5. Name of supplier, distributor and subcontractor as applicable and additional information that clarifies the submittal.
- B. 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 Engineer as "Not Approved" will be returned to the Contractor with copy so noted.
  3. Deliver all submittals to the Engineer's office address indicated on the Contract Documents exclusive of delivery times.
  4. Allow two (2) weeks for review by the Engineer.
  5. 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.
- C. Transmit under separate cover 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 electronic transmittal forms. Re-submittals to have original number with an alphabetic suffix.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Contract Documents.
- E. Schedule submittals to expedite the Project, and deliver to Engineer at business address. Coordinate submission of related items.
- F. Submittals shall include the following:
1. Date and revision dates.
  2. Project title and number.
  3. The names and address of the:
    - a. Engineer
    - b. Contractor
    - c. Subcontractor
    - d. Supplier
    - e. Manufacturer
  4. Identification of product or material and where in the Project the product is to be used, i.e., Room no., location or area of the building where used.
  5. Relation to adjacent structure or materials.
  6. Field dimensions, clearly identified as such.
  7. Specification section number.
  8. Applicable standards, such as ASTM number or Federal Specification.
  9. A blank space, 3 inch by 6 inch for the Engineer's stamp.
  10. Contractor's stamp, initialed or signed, certifying to review of submittal and compliance with Contract Documents.

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- G. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.
- H. Revise and resubmit submittals; identify all changes made since previous submittal.
- I. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

**1.04 CONTRACTOR RESPONSIBILITIES**

- A. The Contractor shall review, approve, and submit with reasonable promptness and in such sequence as to cause no delay in the work, or the work of the Owner or any separate contractor, all shop drawings, product data, and samples required by the Contract Documents.
- B. 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 Engineer.
- C. 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 Engineer. No time extensions will be permitted for this type of re-submittal.
- D. All submittals must bear a stamp indicating that the Contractor has reviewed the submittal prior to forwarding to the Engineer, or they will be returned to the Contractor without action.
- E. Coordinate each submittal with requirements of the Work and of Contract Documents.
- F. The Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Engineer's approval of shop drawings, product data, samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal and the Engineer has given written approval to the specific deviation.
- G. The Contractor shall not be relieved of responsibility for errors or omissions in shop drawings, product data, samples or similar submittals by Engineer's approval thereof.
- H. Begin no work which requires submittals until return of submittals with Engineer's stamp and initials or signature indicating review.
- I. Contractor is responsible for obtaining and distributing required prints of shop drawings, product data, and samples, to his subcontractors and material suppliers, after as well as before final approval. Obtain copies of all shop drawings, product data, and samples to date, accepted from other Contractors.
- J. 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 Engineer, such materials or equipment do not meet the requirements of the Contract Documents.
- K. Shop drawings in both large and small format shall be electronically organized for submission in complete sets.
- L. No xerographic or altered xerographic reproductions of the Contract Documents are permitted as submittals. Facsimiles or copies of facsimiles are not acceptable submittals to be furnished under this section.

**1.05 ENGINEER'S RESPONSIBILITIES**

- A. Review submissions with reasonable promptness for the design concept expressed in the Contract Documents.
- B. 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.
- C. Engineer's review is not for approval of safety precautions, or of construction means, methods, techniques, sequences, or procedures.
- D. Approval of a specific item shall not indicate approval of an assembly of which the item is a component.

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**1.06 SUBMITTAL SCHEDULE**

- A. After development and acceptance of the Contractor's Construction Schedule, prepare a complete schedule of submittals. Submit the schedule within 10 days of the date required for submittal of the Contractor's Construction Schedule.
- B. Prepare the schedule in chronological order. Provide the following information:
  - 1. Scheduled data for the first submittal.
  - 2. Related Section number.
  - 3. Submittal category (shop drawings, product data or samples).
  - 4. Name of the subcontractor.
  - 5. Description of the part of the work covered.
  - 6. Scheduled date for re-submittal.
  - 7. Scheduled date for the Engineer's final release or approval.
- C. Following response to the initial submittal, print and distribute copies to the Engineer, Owner, Prime contractors, and other parties required to comply with scheduled dates. Post copies in the project meeting room and temporary field office.
  - 1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.
  - 2. Revise the schedule after each meeting, event, or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

**1.07 SCHEDULE OF VALUES**

- A. Coordinate preparation of the schedule of values with preparation of the progress schedule.
- B. Correlate line items in the schedule of values with other required administrative schedules and forms, including:
  - 1. Contractor's progress 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 Engineer at the earliest feasible date, but in no case later than 7 days before the date scheduled for submittal of the initial application for payment.
- 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. Name of the Engineer.
  - 3. Project number.
  - 4. Contractor's name and address.
  - 5. 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 Contract 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

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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.

**1.08 PROPOSED PRODUCTS LIST**

- A. Within 15 days after execution of the Owner-Contractor Agreement, submit complete list of major products proposed for use. Prepare a schedule in tabular form showing each products proposed for use in the Work. Include the manufacturer's name and proprietary product names for each item listed.
  - 1. Coordinate the product list with the list of proposed materials manufacturers.
  - 2. Prepare the product listing 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.

**1.09 SHOP DRAWINGS**

- A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of shop drawings. Standard information prepared without specific reference to the Project is not a shop drawing.
- B. Shop drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:
  - 1. Dimensions.
  - 2. Identification of products and materials included by sheet and detail number.
  - 3. Compliance with specified standards.
  - 4. Notation of coordination requirements.
  - 5. Notation of dimensions established by field measurement.
- C. 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 Coordination, and may include components previously shown in detail on shop drawings or product data.
- D. After review, reproduce and distribute in accordance with “Submittal Procedures” above, and for record documents described in Section 01 77 00 –Closeout Procedures.
- E. Electronic files containing AutoCad floor plans and elevations are available through the Engineer for use by Contractors in preparing submittals. These electronic documents are available in the .DXF or .DWG format for AutoCAD Release 2013, at a cost of \$100.00 per sheet and must be requested on the Engineer’s “Computer File Release Application” form which is included in this Project Manual. Form must be signed by the Contractor’s representative who will have the responsibility for payment.

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1. Charges are for the Engineer's time to prepare the sheets in format stated.
2. Drawing files are available through the Engineer's office on a COD basis only.
3. Electronic documents are stripped of the Project's name and address, the Engineer's and his consultants' names and addresses, and any professional licenses indicated on the drawings. All dimensions, verbiage and statistical information will be removed.
4. Use of these electronic documents is solely at the contractors' risk, and shall in no way alter the contractor's responsibilities under the contract for construction.
5. The Engineer shall not be responsible or liable for errors, defects, inexactitudes, or anomalies in the data, information, or documents (including drawings and specifications) caused by the Engineer's or his consultants' computer software or hardware defects or errors; the Engineer's or his consultants' electronic or disk transmittal of data, information or documents; or the Engineer's or his consultants' reformatting or automated conversion of data, information or documents electronically or disk transmitted from the Engineer's consultants to the Engineer.
6. The Contractor waives all claims against the Engineer, his employees, officers and consultants for any and all errors in the electronic documents. Furthermore, the contractor shall indemnify, defend and hold harmless the Engineer, and his consultants together with their respective employees and officers, harmless from and against any claims, suits, demands, causes of action, losses, damages or expenses, (including all attorney's fees and litigation expenses) attributed to errors or defects in data, information or documents, including drawings and specifications, resulting from the contractors' distribution of electronic documents to other contractors, persons or entities.

**1.10 PRODUCT DATA**

- A. Informational product data submittals are not required for specific products named in the specification as approved products unless otherwise specifically required in a specifications section, and if noted as such in the "Proposed Product List" described in this section.
- 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 applicable choices and options. Where printed product data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
  1. Manufacturer's printed recommendations.
  2. Compliance with recognized trade association standards.
  3. Compliance with recognized testing agency standards.
  4. Application of testing agency labels and seals.
  5. Notation of dimensions verified by field measurement.
  6. Notation of coordination requirements.
- D. Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms. Do not proceed with installation until a copy of product data is in the Installer's possession.

**1.11 SAMPLES**

- A. Submit 2 full size, fully fabricated physical Samples unless otherwise provided, cured and finished as specified and physically identical with the material or product proposed. Samples 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.
- B. Mount, display, or package samples in the manner to facilitate review of quantities indicated. Prepare samples to match the Engineer's sample. Include the following information:
  1. Specification Section number and reference.
  2. Generic description of the sample.
  3. Sample source.



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4. Product name or name of manufacturer.
  5. Compliance with recognized standards.
  6. Availability and delivery time.
- C. 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.
- D. 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.
- E. Refer to other Specification sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.
- F. Submit the number of samples specified in individual specification sections; one of which will be retained by Engineer. If not specified, submit one copy.
- G. Reviewed samples which may be used in the Work are indicated in individual specification sections.
- H. Materials and equipment incorporated in the Work shall match the approved samples.
- I. The Contractor shall furnish additional certification of conformance to the specification requirements as may be requested by the Engineer.

**1.12 QUALITY ASSURANCE SUBMITTALS**

- A. Submit quality control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals 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 certification from the manufacturer certifying compliance with specified requirements.
- C. Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.
- D. Requirements for submittal of inspection and test reports from independent testing agencies are specified in Section 01 45 00 – Quality Requirements.

**PART 2 – PRODUCTS**

Not Used

**PART 3 – EXECUTION**

Not Used

**END OF SECTION**

**SECTION 01 35 13**  
**SPECIAL PROJECT PROCEDURES**  
**PROTECTION OF HISTORIC BUILDING FABRIC**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. The work of this section seeks to preserve the character of the historic building by leaving in place and protecting the existing historic materials.
- B. Related Sections:
  - 1. Section 02 41 19 – Selective Demolition
- C. Historic: Words such as "historic", "historic fabric", "historic materials", "historic building materials", or words of similar meaning shall be understood to mean that the material or feature is considered to have aspects that require conservation in accordance with this section, and all work impacting the material or feature shall conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties Standards for Rehabilitation.
- D. Standard of Care: All existing historic building materials and components shall be considered very fragile and must be dismantled, removed, worked on, transported, and in general handled with special care. Contractor shall repair, clean, recreate or otherwise make good any existing materials under Contractor's care, custody, and protection that is damaged.
- E. Existing historic materials may not be available for replacement. If replacement is required, Contractor will be required to repair or recreate to an approved level of authenticity. Costs of such replacement, restoration or recreation may be significant and shall be borne by Contractor.

**1.02 PROTECTION PLAN**

- A. Contractor shall establish and maintain in-force for the duration of the project a Protection Plan that details procedures, materials and sequence of operations necessary to protect existing materials in the historic portions of the project from damage. The Protection Plan shall include procedures to assure a standard of care for each trade or type of protection and:
  - 1. Verification that the proposed protection is necessary to complete the work.
  - 2. Verification of each material composition and layout and appropriate protection techniques.
  - 3. Verification that items to be covered by protection are properly documented prior to application of protection.
  - 4. Verification that proposed protection measures can be removed as necessary for periodic examinations and monitoring measures.

**PART 2 – PRODUCTS**

**2.01 MATERIALS**

- A. General Requirements: Provide protection for work over historic ceilings for materials to be removed, repaired or treated and wherever encountered adjacent to work or along paths of travel to prevent damage to historic ceilings or collapse of areas of work as necessary.
- B. Protection Materials: Provide necessary protective devices, barriers and covering materials for a complete protection installation. Rigid protection shall be provided of sufficient size and thickness to withstand impact from falling debris and residue water from abandoned piping.
  - 1. Polyethylene Sheet: 6 mil
  - 2. Plywood: ½ inch , exterior grade

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**PART 3 – EXECUTION**

**3.01 PROTECTION – GENERAL**

- A. Cover and protect from damage unexposed side of historic decorative ceilings when working above them. Protection materials shall not attach to historic fabric.
- B. Historic Ceilings: Protect work area exposed backside of historic ceilings materials throughout the structure during the course of construction.
- C. Maintenance of protection devices: Protection devices shall be maintained in sound condition until the completion of work. Repair or replace protection devices as necessary to maintain effectiveness of protection. In-place protection devices shall be reviewed periodically.

**3.02 PREPARATION FOR REMOVAL AND DISMANTLING**

- A. Examine construction to be removed or dismantled to determine best methods to safely and effectively perform removal and dismantling work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed or dismantled and location of utilities and services to remain that may be hidden by construction that is to be removed or dismantled.
  - 1. Verify that affected utilities have been disconnected and capped.
  - 2. Inventory and record the condition of items to be removed and dismantled for reinstallation or salvage.

**END OF SECTION**

**SECTION 01 45 00**  
**QUALITY REQUIREMENTS**

**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 testing performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by the Engineer.
- 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-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 Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-control services required by Engineer, 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 33 00 – Submittal Procedures: Submission of manufacturers' instructions and certificates.
  - 3. Section 01 73 29 – Cutting and Patching: Requirements for repair and restoration of construction disturbed by inspection and testing activities.

**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 ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Engineer.
- C. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- D. 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 industry standards.
- E. Special Inspection: Inspection by a testing agency, as required by the International Building Code Chapter 1704, of materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and reference standards.
- 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.

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- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

**1.03 SUBMITTALS**

- A. Schedule of Tests and Inspections: Prepare and submit a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Include Contractor performed tests and those of sub-contractors. Include Special Inspections and testing by third party engaged by the Engineer. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
- B. 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.
- C. 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.
- D. 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.

**1.04 QUALITY ASSURANCE**

- A. 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.
- B. 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.
- C. 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.
- D. 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.

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- E. 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.
- F. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

**1.05 QUALITY CONTROL**

- A. 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.
- B. Contractor Responsibilities: Contractor shall provide quality-control services specified and required by authorities having jurisdiction for their work.
  - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
  - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in triplicate, of each quality-control service to the Engineer, and Owner.
  - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Special Tests and Inspections: Owner may engage a testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.
  - 1. Testing agency will notify Engineer, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  - 2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Engineer, with copy to Contractor and to authorities having jurisdiction.
  - 3. Testing agency will submit a final report of special tests and inspections at Project Completion, which includes a list of unresolved deficiencies.
  - 4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  - 5. Testing agency will retest and reinspect corrected work.
- 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. 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.
- F. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  - 1. Notify Engineer, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  - 2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  - 3. Submit a certified written report, in triplicate, of each test, inspection, and similar quality-control service through Contractor.
  - 4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
  - 5. Do not perform any duties of Contractor.

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- G. Engineers 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, materials, 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. Delivery of samples to testing agencies.
  - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. 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.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for the Notice to Proceed.
  - 1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

**1.06 REFERENCES**

- A. Conform to reference standard by date specified in product sections, or if not indicated, the date of issue current on date of Contract Documents.
- B. Obtain copies of standards when required by Contract Documents.
- C. Should specified reference standards conflict with Contract Documents, request clarification for Engineer before proceeding.
- D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

**1.07 INSPECTION AND TESTING LABORATORY SERVICES**

- A. Provide inspections, tests, and similar quality control services, specified in individual specification sections and required by governing authorities, except where they are specifically indicated to be the Engineer or the Owner's responsibility, or are provided under another identified entity; these services include those specified to be performed by an independent agency and not by the Contractor. Costs for these services shall be included in the base bid contract amount.
- B. Retesting may be required where results of required inspections, tests or similar services prove unsatisfactory and do not indicated compliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility. The cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.
- C. The independent testing agency engaged to perform inspections, sampling and testing of materials and construction specified in individual specification sections shall cooperate with the Engineer and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.
  - 1. The agency shall notify the Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  - 2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
  - 3. The agency shall not perform duties of the Contractor.
- D. Contractor and each agency engaged to perform inspections, tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition the

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Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

- E. The independent testing agency shall submit a certified written report of each inspection, test, or similar service, to the Engineer. Written reports of each inspection, test, or similar service shall include, but not be limited to:
  - 1. Date of issue.
  - 2. Project title.
  - 3. Name, address and telephone number of the testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making the inspection or test.
  - 6. Designation of the Work and test method.
  - 7. Identification of product and Specification Section.
  - 8. Complete inspection or test data.
  - 9. Test results and an interpretation of test results.
  - 10. Ambient conditions at the time of sample-taking and testing.
  - 11. Comments or professional opinion as to whether inspected or tested Work complies with Contract Document requirements.
  - 12. Name and signature of laboratory inspector.
  - 13. Recommendations on retesting.
- F. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
  - 1. Notify Engineer, and independent firm 24 hours prior to expected time for operations requiring services.
  - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- G. Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specializes in the types of inspections and tests to be performed. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State in which the Project is located.
- H. Compile for closeout submittal copies of each test report.

**1.08 MANUFACTURERS' FIELD SERVICES AND REPORTS**

- A. When specified in individual specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, testing, and adjustment as applicable, and to initiate instructions when necessary.
- B. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Submit report in duplicate within 30 days of observation to Engineer for review.

**PART 2 – PRODUCTS**

Not Used

**PART 3 – EXECUTION**

**3.01 REPAIR AND PROTECTION**

- A. Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrate and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with requirements of Section 01 73 29– Cutting and Patching.
- B. Protect construction exposed by or for quality control service activities, and protect repaired construction.



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- C. Repair and protection is the Contractor's responsibility, regardless of the assignment or responsibility for inspection, testing, or similar services.

**END OF SECTION**

**SECTION 01 50 00**  
**TEMPORARY FACILITIES AND CONTROLS**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section includes requirements for construction facilities and temporary controls, including temporary utilities, support facilities, and security and protection.
- B. Support facilities include, but are not limited to, the following:
  - 1. Project signage.
  - 2. On site storage.
  - 3. Temporary access and parking.
  - 4. Dumpsters.
  - 5. Construction aids.
- C. Security and protection facilities include, but are not limited to, the following:
  - 1. Temporary enclosures
  - 2. On-Site Storage
  - 3. Protection of the public
  - 4. Protection of work and property.
  - 5. Temporary fire protection.
  - 6. Temporary exterior barriers.
  - 7. Jobsite maintenance.
  - 8. Environmental protection.
- D. 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.
  - 2. Section 01 35 13 – Special Project Procedures: Protection of Historic Building Fabric.

**1.02 USE CHARGES**

- A. Water Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services required for construction operations.
- 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.

**1.03 DEFINITIONS**

- A. "Maintain" shall mean to keep in service and operation; and to provide such repairs required to keep in continued service and safe, sound condition until and only if directed by the Engineer to be removed.
- B. "Permanent Building Enclosure" shall mean permanent roofing is complete, insulated, and weather tight; and all openings are closed with permanent construction or substantial temporary closures.
- C. "Temporary Enclosure" shall mean installation of roof insulation, membrane and moisture barrier to extent of "dried-in" condition.

**1.04 DESCRIPTION OF REQUIREMENTS**

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

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temporary Work required, and no omission from this section will be recognized as an indication by Engineer 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 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, that 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.

**1.05 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. Municipality regulations.
  - 5. Police and fire department rules.
- B. 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.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- D. 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.
- E. Protect work against damage and maintain work, materials, apparatus and fixtures free from injury or damage in accordance with the General 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 failure to provide protection required, shall be removed and replaced with new work at the Contractor's expense.
- F. 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.

**1.06 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 required by progress of the Work.
  - 3. Temporary facilities and controls shall be removed by the Contractor responsible for the temporary facility and/or controls upon completion of the work, unless otherwise indicated.
- B. Operate 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.

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**PART 2 – PRODUCTS**

**2.01 MATERIALS**

- A. Provide new temporary materials. If acceptable to the Engineer, Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for intended use.
- B. Lumber and Plywood: Comply with requirements in Section 06 10 00 – Rough Carpentry.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- D. 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.

**2.02 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**

- A. 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 needed.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required for the work. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- C. Remove each temporary facility when the need has ended, when replaced by authorized use of permanent facility, or no later than Substantial Completion. Complete, or if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

**3.02 WATER FOR CONSTRUCTION USE**

- A. Water is available at the existing building.
- B. Furnish the necessary hoses, nozzles, connectors, accessories and temporary extensions to properly service his own requirement, and Contractors shall be held responsible for damage resulting from his careless use of water.
- C. Provide potable drinking water facilities for the workers. The temporary water service is a potable water service. Contractor may use this as a source or provide his own water.

**3.03 POWER**

- A. Electric service is available at the building.
- 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 stone or decorative floor or wall finishes.
- C. Complete all work in conformance with requirements of the National Electric Code, OSHA, and the Authority Having Jurisdiction.

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**3.04 SANITARY FACILITIES**

- A. Permanent toilet facilities in the existing building may be used by construction personnel.

**3.05 TEMPORARY ENCLOSURES**

- A. 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 openings.
  - 1. Provide necessary measures to protect temporary and final work, existing building, material and equipment from weather damage. This includes ground water, rainwater, wind, ice, snow and the backing up of sewers and drains.
  - 2. Maintain existing roof drains and protect areas of partial demolition until area is enclosed and weather tight.

**3.06 PROTECTION OF WORK AND PROPERTY**

- A. Protect the work in progress in accordance with the provisions of this article and the provisions of individual specification sections.
- B. See also AIA A104 Article 16, "Protection of Work and Property."
- C. Protect work from weather, and maintain the Work and all materials, apparatus, and fixtures free from injury or damage until Final Acceptance.
  - 1. Work likely to be damaged shall be covered or protected at all times to prevent damage.
  - 2. Work damaged by failure of the Contractor to provide coverage or protection shall be removed and replaced with new Work at the Contractor's expense.
  - 3. Adjacent property, including without limitation roads, walks, shrubbery, plants, trees or turf, damaged during the Contractor's Work shall be properly repaired or replaced at the Contractor's expense.
- D. Protect the project and existing or adjacent property from damage at all times and shall erect and maintain necessary barriers, furnish and keep lighted necessary danger signals at night, and take precautions to prevent injury or damage to individuals or property.
- E. Protect buildings, equipment, furnishings, grounds and plantings from damage. Damage shall be repaired or otherwise made good at no expense to the Owner.
- F. Provide protective coverings and barricades to prevent damage. The Contractor shall be held responsible for, and must make good at his own expense, any water or other type of damage due to improper coverings.
- G. Provide protective coverings for walls, projections, jambs, sills and soffits of openings. Protect finished floors and stairs from traffic, movement of heavy objects and storage.

**3.07 ON-SITE STORAGE**

- A. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of materials to minimize the opportunity for theft and vandalism.
- B. Provide suitable weathertight storage sheds of sufficient size to hold materials required on the site at one time, for storage of materials which might be damaged by the weather. Storage area on the site will be designated.
- C. Coordinate available space; under no circumstances will any materials be stored outside of the construction limits.

**3.08 PROTECTION AND USE OF ELEVATOR**

- A. Existing Elevator Use: Use of Owner's designated existing elevator will be permitted, provided elevator are cleaned and maintained in a condition acceptable to Owner.
  - 1. Do not load elevators beyond their rated weight capacity.

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2. Provide protective pads for cab wall coverings, Plywood sheet material for floor protection, and other procedures to protect elevator car and entrance doors and frame.
3. Use of other elevators is not permitted.

**3.09 TEMPORARY FIRE PROTECTION**

- A. Take all necessary precautions to guard against and eliminate all possible fire hazards and to prevent damage to any construction work, building materials, equipment, and all other property, both public and private. Take precaution to prevent fire hazards in accordance with all fire protection regulations and codes, including the following:
1. Prohibit smoking on construction site.
  2. FIRE EXTINGUISHERS: Provide and maintain in working order, at all times during construction, fire extinguishers conveniently located for proper protection. Personnel working on the Project shall be familiarized with the locations and operation of fire extinguishers.
  3. Store combustible materials in containers in fire safe locations.
  4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for fighting fires.
  5. In case of fire, notify the fire department immediately. Contractor's workmen shall assist in extinguishing the fire until firefighting personnel arrives.
  6. Perform no welding, flame cutting or other operations involving the use of flame, arcs or sparking devices without adequate protection and shielding. Remove all combustible and flammable materials from the immediate working area. If removal is impossible, protect all flammable or combustible materials. Provide the necessary personnel and firefighting equipment to effectively control any fire resulting from welding, flame cutting or other operations involving the use of flame, arcs or sparking devices.
  7. For all flammable liquids having a flash point of 110 degrees F. or below, use Underwriter's Laboratories' labeled safety cans. Store the bulk supply of all flammable liquid at least 75 feet from the building and yard storage of building materials. Spigots on drums containing flammable liquids are prohibited on the project site. Drums shall be equipped with approved vent pumps.
  8. Use only fire resistant tarpaulins.
  9. Develop and supervise an overall fire-prevention and first aid fire-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.
  10. Provide fire watch for all open flame activities.

**3.10 PROTECTION OF THE PUBLIC**

- A. All necessary precautions to prevent injury to the public or damage to property of others shall be taken.
- B. When necessary to maintain Public use of work areas involving vehicular roadways, etc., the Contractor shall protect the Public in accordance with the applicable regulations;
- C. When necessary to maintain Public use of work areas involving sidewalks, entrances to buildings, lobbies, corridors, aisles, stairways, vehicular roadways, etc., the Contractor shall protect the Public in accordance with all applicable laws and regulations;
- D. Sidewalks, entrances to buildings, lobbies, corridors, aisles, doors or exits shall be kept clear of obstructions, holes, materials, water intrusion and other conditions to permit safe ingress and egress of the Public at all times;
- E. Appropriate warnings, signs and instructional safety signs shall be conspicuously posted where necessary.
- F. Signs, signals or other control devices used to regulate vehicular traffic shall meet the requirements of the local authority having jurisdiction for work on or near Project Site.
- G. All signage warnings and traffic control shall comply with the requirements of the local authority having jurisdiction;
- H. Required signs and symbols shall be visible at all times when work is being performed and shall be removed or covered promptly when the hazards no longer exist;
- I. Barricades, cones, and/or similar channeling devices shall be used whenever employees or the Public are exposed to traffic or similar hazards;

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- J. When traffic patterns are closed or altered due to work activity, instructional or warning signs shall be posted;
- K. Public walkways and roadways shall be kept clean and free of all recognized hazards and maintained for the safe and unobstructed movement of pedestrian and vehicular traffic;

**3.11 WEATHER PROTECTION**

- A. Weather Protection: Protect the Work against weather damage, and maintain the work, materials, and equipment free of injury or damage during the entire construction period.
- B. At all time that roofing work is in progress, provide such protection measures to assure that the roofing system remains watertight.

**3.12 DUMPSTERS**

- A. Provide dumpsters to service the project. Contractors failing to load dumpsters properly and/or failing to break down cartons, piping, etc. will be charged for removal of partially filled dumpsters. Schedule all dumpster deliveries and pickups. The site will allow a dumpster located as directed by the Owner.
- B. 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 Engineer, at the delinquent Contractor's expense, including replacement of material, if required.
- C. 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.
- D. No burning of trash or debris is allowed.

**3.13 TEMPORARY ACCESS AND PARKING**

- A. Traffic Controls: The Contractor to comply with requirements of authorities having jurisdiction.
  - 1. Contractor shall assign a workman to assist construction vehicles arriving and departing the construction site and to monitor and protect vehicular and pedestrian traffic.
  - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- B. Parking in the library parking garage is available to contractors whose vehicles meet the requirements for vehicle parking. Vendors are responsible for their own downtown parking.

**3.14 CONSTRUCTION AIDS**

- A. Engineer's Access to the Work: Facilitate access to the worksites for the Engineer and Owner's representative examination of all portions of the Work while in progress, and during closeout phase of the work. The Engineer 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 Engineer.
- B. 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 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.
- C. Protect permanent construction from damage, staining, or marring due to use of chutes, hoists, scaffolds, staging, etc.
- D. Hoists: Provide, erect, and maintain adequate temporary construction hoists required for the prosecution of the work.
- E. Provide scaffolds, ladders and vertical transportation required for the Work. Use of existing stairs will be permitted.
- F. Do not free-drop materials, rubbish or debris.

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**3.15 PROJECT SIGNAGE**

- A. Provide signage required for hazards, safety and protection of persons and property during construction.
- B. Provide safety signage to facilitate the Contractor's work.

**3.16 JOBSITE MAINTENANCE**

- A. Comply with all governing traffic control regulations. Clean streets, sidewalks, paved areas, etc., during progress of the work.
- B. 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.
- C. At the completion of portions of the Work and the entire completion of Project, remove all tools, equipment, scaffolds, and surplus materials. Execute all required final cleaning.
- D. Environmental Protection: Provide protection, operate temporary facilities, and conduct cleaning and repair in ways and by methods that comply with environmental regulations, and minimize the possibility that the building interior, building air handling and HVAC systems, external atmospheric air, waterways, and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment that produce harmful noise.

**END OF SECTION**



**SECTION 01 60 00**  
**PRODUCT REQUIREMENTS**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections/Documents:
  - 1. Section 01 33 00 – Submittal Procedures: Requirements for submittals.
  - 2. Section 01 77 00 – Closeout Procedures 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. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
- C. "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.
- D. "New Products" Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
- E. "Comparable Product" is a product that is demonstrated and approved through 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 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 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 Engineer 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 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.

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**1.04 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 at the project site in a manner that will facilitate inspection and measurement of quantity or counting of units.
  6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
  7. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.

**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 Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.
  2. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
  3. Provide products which are free of asbestos and lead.
  4. Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

**2.02 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
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," Engineer will make selection.
  5. Where products are accompanied by the term "match sample," sample to be matched is Engineer's.
  6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
  7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or 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 name a specific product and manufacturer, provide the specified product

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2. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
3. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
4. 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.
5. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, that complies with requirements..

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

- A. Install, erect, connect, condition, use, adjust, and clean products in accordance with manufacturer's instructions and in conformity with specified requirements.
  1. Verify and coordinate clearances, dimensions and installation of adjoining construction, equipment, piping, ducts, conduits, or other mechanical or electrical items or apparatus.
  2. Prior to fabrication, field measure actual existing conditions to ensure proper fit.
  3. Inspect each item of material or equipment immediately prior to installation. Reject damaged and defective items.
  4. Recheck measurements and dimensions of Work, as an integral step of starting each installation. Whenever stock manufactured products are specified, verify actual space requirements for setting or placing into allotted space. No extra cost will be allowed for adjustment of Work to accommodate particular product.
- B. 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.
  4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.
- C. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- D. Install products at the time and under conditions that will ensure the best possible results in coordination with entire project. Maintain conditions required for product performance until Substantial Completion.
  1. Isolate each unit of work from incompatible work as necessary to prevent deterioration.
  2. Coordinate enclosure of work with required inspections and tests to minimize necessity of uncovering work for those purposes.
- 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. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. 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.
- H. Attachment: Provide attachment and connection devices and methods for securing work to withstand stresses, vibration, physical distortion, disfigurement, or racking.
  1. Anchors and Fasteners: Provide anchors and fasteners to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  2. Mounting Heights: Where not indicated, mount individual units of work at industry recognized standard mounting heights for particular application indicated.
    - a. Refer questionable mounting heights choices to Engineer for final decision.
    - b. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.

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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.
  4. Secure work true to line and level, and within specified tolerances, or if not specified, industry recognized tolerances. Allow for building movement, including thermal expansion and contraction.
  5. Physically separate, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
- I. 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. Refer questionable visual-effect choices to Engineer for final decision.
  - J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
  - K. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components to ensure operability without damaging effects.
  - L. Adjust operating products and equipment to ensure smooth and unhindered operation.

**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. Installation of the Work.
  - 2. Progress cleaning.
  - 3. Starting and adjusting.
  - 4. Protection of installed construction.
  - 5. Correction of the Work.
- B. Related Sections include the following:
  - 1. Section 01 31 00 – Project Coordination for procedures for coordinating field engineering with other construction activities.
  - 2. Section 01 33 00 – Submittal Procedures for submitting surveys.
  - 3. 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.
  - 4. Section 01 77 00 – Closeout Procedures for submitting final property survey with Project Record (As-Built) Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

**1.02 ACTION SUBMITTALS**

- A. Provide the following in conformance with Section 01 30 00 – Submittal Procedures.
- 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 Engineer 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 of mechanical and electrical systems, and other construction affecting the Work.
- 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 existing mechanical and electrical systems on roof to verify actual locations of connections before equipment and fixture installation removal and reinstallation.
  - 2. Examine roofs for suitable conditions where products and systems are to be installed.

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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 services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements 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 Engineer according to requirements in Section 01 31 00 – Project Coordination.

**3.03 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.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. 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.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. 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.
- H. 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. Allow for building movement, including thermal expansion and contraction.
  2. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral

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anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

**3.04 CUTTING AND PATCHING**

- A. Refer to Section 01 73 29 – Cutting and Patching.

**3.05 PROGRESS CLEANING**

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. 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 materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
- 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.

**3.06 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 40 00 – Quality Requirements."

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**3.07 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. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

**3.08 CORRECTION OF THE WORK**

- A. Restore permanent facilities used during construction to their specified condition.
- B. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- C. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

**END OF SECTION**



**SECTION 01 73 29**  
**CUTTING AND PATCHING**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section includes requirements and limitations for cutting and patching of the Work.
- B. Related Sections:
  - 1. Drawings and general provisions of the Contract, including General Conditions and Division 01 specification sections, apply to work of this section.
  - 2. Divisions 02 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
  - 3. Section 01 33 00 – Submittal Procedures.
  - 4. Section 01 35 13 – Special Project Procedures – Protection of Historic Building Fabric

**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.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

**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. Give a schedule of dates when work is expected to be performed.
  - 4. List products, equipment, and techniques to be used and firms that will perform work.
  - 5. Where cutting and patching of structural work involves the addition of reinforcement it shall be integrated with original structure to satisfy requirements.
  - 6. Approval by the Engineer to proceed with cutting and patching work does not waive the Engineer's right to later require complete removal and replacement of work found to be cut and patched in an unsatisfactory manner.
  - 7. Furnish protection from dust and noise to occupied areas.
  - 8. Furnish adequate collection and removal of water for concrete cutting and coring.

**1.04 QUALITY ASSURANCE**

- A. 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.
- B. Cut and patch in a manner compatible with scheduled new work and finishes. Do not cut and patch work in a manner that would result in visible telegraphing through new finishes. Review cut and patch procedures involved in the work with the Engineer prior to start of such work. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. 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 Engineer 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.

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- D. Operational Elements: Do not cut and patch operating elements and 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.
- E. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity or 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 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. Each Contractor is responsible for the cutting and patching required for installation of their work, except as otherwise shown on the drawings.
- C. Each Contractor shall determine the location and size of opening required for the installation of their work. Cost of cutting and patching shall be borne by the Contractor requiring the opening or access.
- D. Each Contractor shall coordinate the locations and installation of sleeves and supporting devices to be installed in the construction for the installation of their work in the new construction.

**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.

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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 PERFORMANCE**

- 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. For new openings greater than 15" wide, provide new steel lintel per requirements indicated in the structural drawings.
- C. Cut, fit and patch 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 Engineer's observation of covered work which has been covered up prior to required observation by Engineer.
- D. Employ skilled workmen capable of matching existing quality of workmanship to perform cutting and patching work. Proceed with cutting and patching at the earliest feasible time and complete work without delay.
- E. 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. Remove existing construction as noted or required to be removed in order to accommodate new work.
- F. 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. Inspect and test patched areas to verify integrity of the installation.
  4. Restore surfaces and conditions exposed by removal of existing equipment, features and items, i.e., holes, recesses, interruption of continuity of finishes, etc.
  5. 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.

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

**3.04 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.

**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. Inspection procedures.
  - 2. Project Record (As-Built) Documents.
  - 3. Operation and maintenance manuals.
  - 4. Warranties.
  - 5. Instruction of Owner's personnel.
  - 6. Cleaning during construction and final cleaning.
- B. Related Sections/Documents:
  - 1. Drawings and general provisions of Contract, including General Conditions and Division 01 Specification sections, apply to Work of this section.

**1.02 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 49.
  - 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.

**1.03 CLEANING DURING CONSTRUCTION**

- A. Clean and protect construction in progress and adjoining materials in place during handling and installation. Apply protective covering where required to assure protection from damage or deterioration until Individual Substantial Completion dates.
- B. Deposit rubbish, scrap materials, debris, etc., in dumpsters (in a specified location). The Contractor shall be responsible for the removal from the jobsite and proper disposal of the waste materials. Absolutely no burning of debris or trash will be allowed.
- C. During the progress of the work, remove all waste materials and rubbish and deposit such waste in the project dumpster. Perform daily broom cleaning in the area of the Contractor's work. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period.
  - 1. Keep the premises free at all times from all waste materials, packaging materials and other rubbish accumulated in connection with the execution of work by collecting and depositing said materials and rubbish in locations or containers as designated by the Contractor.
  - 2. Clean and remove from own work soiling, staining, mortar, concrete or dirt caused by the execution of work and make good additional defects resulting therefrom.
  - 3. At the completion of portions of the Work and the entire completion of work, remove all tools, equipment, scaffolds, shanties, and surplus materials. Execute all required final cleaning.

**1.04 PREREQUISITES TO INDIVIDUAL SUBSTANTIAL COMPLETION DATES**

- A. General: Prior to requesting inspection for certification of substantial completion (for either entire Work or portions thereof), complete the following and list known exceptions in request:

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1. In progress payment request, coincident with or first following date claimed, show either 100 percent completion for portion of Work claimed as "substantially complete," or list incomplete items, value of incompleteness, and reasons for being incomplete.
  2. Submit statement showing accounting of changes to the Contract Price.
- B. Inspection Procedures: Upon receipt of Contractor's request, Engineer will either proceed with inspection or advise Contractor of pre-requisites not fulfilled. Following initial inspection, Engineer will either prepare individual certificates of substantial completion, or advise Contractor of Work which must be performed prior to issuance of certificate; and repeat inspection when requested and assured that Work has been substantially completed. Results of completed inspection will form initial "punch-list" for final acceptance.

**1.05 PREREQUISITES TO FINAL ACCEPTANCE**

- A. General: Prior to requesting Engineer's final inspection for certification of final acceptance and final payment, required by General Conditions, complete the following and list known exceptions (if any) in request:
1. Submit final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
  2. Submit updated final statement, accounting for additional (final) changes to Contract Sum.
  3. Submit copy of Engineer's final punch-list of itemized Work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by the Engineer.
  4. Revise and submit evidence of final, continuing insurance coverage complying with insurance requirements.
  5. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents.
  6. Obtain and submit releases enabling Owner's full and unrestricted use of Work and access to services and utilities, including (where required) occupancy permits, operating certificates, and similar releases.
  7. Submit record drawings, maintenance manuals, and similar final record information.
  8. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities and services from the project site, along with construction tools, facilities and similar items.
  9. Complete final cleaning up requirements.
- 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, Engineer will re-inspect the Work. Upon completion of re-inspection, Engineer will either prepare certificate of final acceptance or advise Contractor of Work not completed or obligations not fulfilled required for final acceptance. If necessary, procedure will be repeated.

**1.06 LIST OF INCOMPLETE ITEMS (PUNCH LIST)**

- A. Preparation: Submit three copies of list for each phase. 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 Engineer.
    - d. Name of Contractor.
    - e. Page number.
- 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, Engineer will re-inspect the Work. Upon completion of re-inspection, Engineer

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will either prepare certificate of final acceptance or advise Contractor of Work not completed or obligations not fulfilled for final acceptance. If necessary, procedure will be repeated.

**1.07 RECORD (AS-BUILT) DOCUMENT SUBMITTALS**

- A. Maintain at the site one set of documents marked as "Record Documents;" maintain in up-to-date and correct condition; do not permanently conceal any Work until required information has been recorded.
- B. Record (As-Built) Drawings: Maintain a clean undamaged set of blue or blackline white-prints of Contract drawings and shop drawings. Mark set to show actual installation where the installation varies substantially from the work as originally shown. Mark the drawing that 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 that would be difficult to measure and record at a later date.
  - 1. Mark record sets with a colored erasable pencil. Use other colors to distinguish between Prime Contracts as follows:
    - a. General Trades: Red
    - b. Plumbing: Blue
    - c. HVAC: Orange
    - d. Electrical: Green
    - e. Fire Protection: Purple
  - 2. Mark new information that is important to the Owner but was not shown on Contract drawings or shop drawings.
  - 3. Note related change-order numbers where applicable.
  - 4. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
- C. Electronic Submittals: Drawings
  - 1. Initial Submittal: Submit one set(s) of corrected Record CAD Drawings in electronic AutoCAD .dwg format and original set(s) of marked up Record prints for review of content and drafting quality. The following file formats will not be accepted: (.tif, .jpg, .jpeg, .pdf). Engineer will return Record (as-built) Drawings and prints for organizing into final submittal.
  - 2. Final Submittal: Submit one set(s) of Record CAD Drawings, original set of marked-up Record (as-built) prints, and five (5) copies printed form Record CAD drawings. Print each drawing, whether or not changes and additional information were recorded.
- D. Record (As-Built) Specifications: Maintain one copy of the Project Manual, including addenda. Include with the Project Manual one copy of other written construction documents, such as change orders and modifications issued in printed form during construction.
  - 1. 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 the manufacturer's installation instructions and recommendation.
  - 2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
  - 3. Note related record drawing information and product data.
  - 4. Upon completion of Work, submit record specifications to the Engineer for the Owner's records.
- E. Record (As-Built) Product Data: Maintain one copy of each project data submittal. Note related Change Orders and markup of record drawings and specifications.
  - 1. 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 the manufacturer's installation instructions and recommendations.
  - 2. Give particular attention to concealed products and portions of the work that cannot otherwise be readily discerned later by direct observation.
  - 3. Upon completion of markup, submit complete set of record product data to the Engineer for the Owner's records.
- F. 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

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miscellaneous records properly and bind or file, ready for continued use and reference. Submit to the Engineer for the Owner's records.

**1.08 OPERATING AND MAINTENANCE MANUALS**

- A. Refer to Section 20 05 20 – Record and Information Manuals.

**1.09 WARRANTIES REQUIREMENTS**

- A. Refer to individual sections of Divisions 02 through 49 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).
- B. 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.
- C. 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.
- D. 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.
- E. 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.
- F. 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.
- G. 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.
- H. Submit written warranties to the Engineer prior to the date for Final Completion. If the Engineer's certificate of Final completion designates a commencement date for warranties other than the date of Final completion for the Work, or a designated portion of the work, submit written warranties upon request of the Engineer.
- 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 Engineer, for approval prior to final execution. Refer to Divisions 01 through 49 sections for specific content requirements and particular requirements for submitting special warranties.
- J. At Final Completion compile 2 copies of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an 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**

Not Used



**PART 3 – EXECUTION**

**3.01 FINAL CLEANING**

- A. Provide final cleaning operations when required. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of work to condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's instructions for cleaning operations.
- B. 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. 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.
  - 4. Remove debris and surface dust from limited access spaces including plenums, shafts, equipment vaults, and similar spaces.
  - 5. Broom clean concrete floors in unoccupied spaces.
  - 6. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo if required.
  - 7. Remove labels that are not permanent labels. Clean all permanent labels.
  - 8. 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 of repair or restoration. Do not paint over UL and similar labels including mechanical and electrical identification plates.
  - 9. Leave Project clean and ready for occupancy.
- C. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during remainder of construction period.
- D. Compliances: Comply with safety standards and governing regulations for cleaning operations. Remove waste materials from site and dispose of in lawful manner.
  - 1. Where extra materials of value remain after completion of associated construction have become the Owner's property, coordinate disposition of these materials to Owner's best advantage as directed.

**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 existing construction.
  - 2. Salvage of existing items to be reused or recycled.
  - 3. Removal and disposal of all debris.
  - 4. Disconnecting and relocating/reinstalling any existing utility lines on the site which interferes with the repairs.
  - 5. 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 35 13 – Special Project Procedures: Protection of Historic Building Fabric.
  - 3. Section 01 50 00 – Temporary Facilities and Controls: Temporary Utilities and Protection requirements during construction operations.
  - 4. Section 01 73 00 – Cutting and Patching
  - 5. 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.
- 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.

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**1.04 PREDEMOLITION MEETING**

- A. Predemolition Conference: 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. 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.
- C. Inventory: Submit a list of items to be removed and reinstalled and items to be removed and salvaged.
- D. Predemolition Photographs or Video: Submit before Work begins.
- E. 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.

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- B. Accurately record actual locations of capped utilities, subsurface obstructions, and utility lines, on project record documents.

**1.08 QUALITY ASSURANCE**

- A. Lead: Due to the age of this building, assume it contains lead-based paint. Contractors must conform to OSHA standards. Construction work is to be conducted in a lead-safe manner, including restricting access to work areas, collection and disposal of paint chips and/or painted components, and daily site cleanup procedures.
- B. 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
- C. Do not use jack hammers or other heavy duty impacting type tools for demolition work without permission of the Architect.
- D. Verify that utility supply lines have been shut off before removal.
- E. Provide fire extinguishers on site of multi-use type during demolition work.
- F. Comply with applicable safety codes for demolition work.
- G. Pay all required fees and obtain all necessary permits and licenses required for demolition work.

**1.09 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.

**1.10 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. Carefully inspect the construction work area and items designated to be removed or preserved. Refer questions to the Architect before proceeding with the work.
- D. Examine all adjoining work which may affect in any way selective demolition work.
- E. 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.
- F. 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.
- G. If removal of an item is required for access to work to be selectively demolished, that item shall be removed, protected, maintained in its original condition, and reinstalled in the work, unless otherwise noted.
- H. 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.

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**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.

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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 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 protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  2. 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.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  5. 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.
- 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.

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**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 area.
  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.

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- 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 06 10 00**  
**ROUGH CARPENTRY**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. This section includes rough carpentry work including the following:
  - 1. Blocking used with roofing modifications
  - 2. Concealed blocking for support of accessories,, equipment, fixtures, specialty items, trim and facing materials.
  - 3. Rough hardware and accessory materials.
- B. Related Sections:
  - 1. Section 07 01 50 – Existing Roofing Modifications
  - 2. Section 07 62 00 – Sheet Metal Flashing

**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. AWPA – American Wood Protection Association:
    - a. AWPA M4 – “Standard for the Care of Preservative Treated Wood Products.”
    - b. AWPA U1 – Use Category System: User Specification for Treated Wood.
  - 2. NELMA: Northeastern Lumber Manufacturers Association
    - a. Standard Grading Rules for Northeastern Lumber.
  - 3. NLGA – National Lumber Grades Authority.
  - 4. SPIB – Southern Pine Inspection Bureau.
    - a. Standard Grading Rules for Southern Pine Lumber.
  - 5. U.S. Department of Commerce, National Institute of Standards and Technology; Product Standards (PS): Softwood Lumber and Plywood Standards:
    - a. DOC PS20 – "American Softwood Lumber Standard."

**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.

**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. 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.

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**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Stack lumber 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 pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.
- B. Store, handle, and protect treated lumber 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 wood or is specified to be treated, comply with applicable requirements of AWPA Standards U1, Use Category UC3b for exterior construction not in contact with ground. Mark each treated item with the ALSC Board of Review.
  - 1. Use treatment containing no arsenic or chromium.
  - 2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
  - 3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
  - 4. Wood preservative shall be approved by the EPA.
  - 5. Wood preservative shall be approved by roofing materials manufacturer when used in connection with roofing & reroofing work.
  - 6. Fasteners used with preservative-treated lumber in connection with re-roofing work shall be of stainless steel.

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7. Metals other than stainless steel shall not come in contact with preservative-treated lumber when used in connection with roofing & re-roofing work.
- B. Preservative Treatment: Pressure treat above ground items with waterborne copper quaternary preservatives (ACQ) to a minimum retention of 0.20 pcf. For exterior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  2. Wood sills, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

**2.03 MISCELLANEOUS LUMBER**

- A. Lumber shall be kiln-dried to an amount not to exceed 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- B. Grade and trademark shall be on each piece of lumber (or bundle in bundled stock). Use only recognized official marks of Association under whose rules it is graded.
- C. Lumber shall comply with PS 20-20 or the most current and shall be identified with grade mark. Lumber shall be sound, thoroughly seasoned, well manufactured, and free from warp that cannot be corrected in the process of bridging, bolting or nailing.
- D. Grades and Species of Solid Wood - Minimum Requirements (See roof system technical specification scope of work and project drawings for other specific wood related requirements):
1. Blocking and nailers shall be No. 2 Southern yellow pine unless otherwise noted on drawings.

**2.04 FASTENERS**

- A. All fasteners shall be corrosion-resistant stainless steel threaded screw fasteners unless otherwise noted, to meet/exceed Factory Mutual Standard 4470 (current edition). Note: Fastener materials shall be compatible with contact materials.
- B. 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. Mechanically galvanized fasteners and connectors are prohibited. Fastener metal type for flashings shall match the flashing metal type. Expansion type fasteners are prohibited for use in stone and brick. 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.
- C. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Nails, Wire Brads, and Staples: FS FF-N-105.
  2. Power Driven Fasteners: National Evaluation Report NER-272.
  3. Wood Screws: ANSI B18.6.1.
  4. Lag Bolts: ANSI B18.2.1.
  5. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.
- D. Use of power-actuated nails for attaching blocking or nailers to concrete is unacceptable.

**2.05 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.
- 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 butts 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. Install appropriate concealed blocking, headers, and supports, to receive fixtures, accessories and similar items mounted on gypsum board partitions as may be required.

**END OF SECTION**

**SECTION 07 01 50**  
**EXISTING ROOFING MODIFICATIONS**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Provide labor, materials, and equipment necessary for complete coordination of installation of roofing materials for roof modification work to accommodate rooftop HVAC equipment.
  - 1. The work of this Section consists of additions to the existing warranted Sarnafil roof system to accommodate HVAC modifications.
  - 2. This Work includes removal of existing roofing materials as required for new work, and installation and tie-in of new materials to existing after modifications to roofing for new openings, roof top equipment and other new construction affecting existing roofing materials.
  - 3. New roofing materials shall be the same materials of the same manufacturer that is currently installed on the building.
- B. Related Sections:
  - 1. Section 01 50 00 – Temporary Facilities and Controls for temporary construction and environmental-protection measures for roof modifications preparation.
  - 2. Section 01 73 00 – Cutting and Patching for cutting and patching procedures for roof preparation.
  - 3. Section 06 10 00 – Rough Carpentry for wood nailers, cants, curbs, and blocking.
  - 4. Division 23 – HVAC/Mechanical.
  - 5. Division 26 – Electrical.

**1.02 DEFINITIONS**

- A. Roofing Terminology: Refer to the following publications for terms related to roofing work not otherwise defined in this section.
  - 1. ASTM D 1079: Definitions of Terms Relating to Roofing, Waterproofing, and Bituminous Materials.
  - 2. NRCA Roofing and waterproofing Manual.
  - 3. Roof Consultants Institute Glossary of Terms.
  - 4. Existing Membrane Roofing System: PVC roofing membrane, surfacing, and components and accessories between deck and roofing membrane.
  - 5. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and reinstalled.
  - 6. Existing to Remain: Existing items of construction that are not indicated to be removed.

**1.03 ACTION SUBMITTALS**

- A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit the following product data to substantiate that the products being installed are the same as existing.
  - 1. Submit two (2) copies of the manufacturer's current: Published installation instructions; flashing and roofing specifications; Product Data Sheets for all products; and Material Safety Data Sheets for all products used in the assembly of the roof system.
  - 2. Manufacturer's complete recommended maintenance procedures for roofing system, including precautions and warnings to prevent damage to, and deterioration of roofing system, and any safety precautions published by the roof system manufacturer.
- C. Quality Control Submittals:
  - 1. Applicator's Certification: Letter from the existing roof system manufacturer certifying that the applicator is licensed or approved to perform the Work of this Section.
  - 2. Material Certification: Letter from the existing roof system manufacturer certifying that the materials used for the Work of this Section are approved for use with the existing system.
  - 3. Warranty Certification: Letter from the existing roof system manufacturer certifying that the Work of this Section will not modify or void the existing warranty.

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**1.04 QUALITY ASSURANCE**

- A. Contractor shall obtain from the Owner a copy of the current warranty.
- B. Contractor shall notify roofing system manufacturer of all changes and revisions required to existing roof so as not to void existing warranty. Existing warranty shall remain in effect.
- C. Installer Qualifications: Installer of membrane roofing system modifications shall be approved by warrantor of existing roofing system to work on existing roofing.
- D. The roofing installer shall have on the job whenever roofing work is being done, a foreman/supervisor with a minimum 3 years' experience in the type of roofing specified. The roofing manufacturer's technical field representative shall visit the site to approve the repairs and installation of new items in order to verify continuation of existing warranty.
- E. Roofing Modification Conference: Conduct conference at Project site to 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. 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 roof modifications including installers of roof accessories and roof-mounted equipment.
  - 2. Review methods and procedures related to roof modification preparation, including membrane roofing system manufacturer's written instructions.
  - 3. Review temporary protection requirements for existing roofing system that is to remain, during and after installation.
  - 4. Review roof drainage during each stage of roof modification and review roof drain plugging and plug removal procedures.
  - 5. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 6. Review procedures to determine condition and acceptance of existing deck for reuse.
  - 7. Review structural loading limitations of deck during roof modification.
  - 8. Review base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that will affect roof modification.
  - 9. Review HVAC shutdown and sealing of air intakes if required.
  - 10. Review governing regulations and requirements for insurance and certificates if applicable.
  - 11. Review existing conditions that may require notification of Architect before proceeding.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's original, unopened containers and rolls with labels intact and legible. Materials having fire resistance classifications shall be delivered to the Project with labels attached as required. Deliver materials in sufficient quantity to allow continuity of work.
- B. Products shall be stored indoors or in properly protected areas outdoors to provide continuous protection against wetting and moisture absorption. Emulsion shall be stored in temperature above 40 degrees F.
  - 1. Materials stored outdoors shall be on raised platforms and cover top and sides with waterproofed materials properly tied down. Remove wet products from project site.
  - 2. Handle roll goods as to prevent damage to edge or ends.
  - 3. Provide continuous protection of products during delivery, storage, handling, and application.
  - 4. Do not store roofing materials in concentrated areas of roof deck.
- C. 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.

**1.06 PROJECT CONDITIONS**

- A. Protect building roofing modifications, from damage or soiling from roof modification operations.
- B. Conduct roof modification so Owner's operations will not be disrupted. Provide Owner with not less than 24 hours' notice of activities that may affect Owner's operations.

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1. Coordinate work activities daily with Owner so Owner can place protective dust or water leakage covers over sensitive equipment or furnishings, shut down HVAC and fire-alarm or detection equipment if needed, and evacuate occupants from below the work area if desired.
- C. Limit construction loads on roof to rooftop equipment wheel loads for uniformly distributed loads.
- D. Weather Limitations: Proceed with roof modification preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into existing roofing system or building.
  1. Apply in dry weather on a dry deck only. Where rain or inclement weather occur during application, the Work shall stop and not resume until the weather has cleared and the deck is properly dry.

**1.07 COORDINATION**

- A. Coordinate associated trades required for modifications to plumbing, mechanical and electrical work as required.

**1.08 WARRANTY**

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during roof modification, by methods and with materials so as not to void existing roofing system warranty. Notify warrantor before proceeding.
  1. Notify warrantor of existing roofing system on completion of roof modification, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

**PART 2 – PRODUCTS**

**2.01 MATERIALS**

- A. Membrane shall conform to ASTM D4434 "Standard for Polyvinyl Chloride Sheet Roofing", Type II, Grade I.
- B. Basis-of-Design Product:
  1. Sarnafil membrane (to match existing roofing).
- C. Membrane:
  1. Sarnafil G410-15 thermoplastic membrane with fiberglass reinforcement.
  2. Thickness: Minimum 60 mils nominal.
  3. Exposed Face Color: Energy Smart white.

**2.02 FLASHING MATERIALS**

- A. Wall/Curb Flashing:
  1. Fiberglass reinforced membrane adhered to approved substrate using adhesive approved by manufacturer: Sarnafil G410 Membrane.
- B. Miscellaneous Flashing:
  1. Heavy-duty, extruded aluminum flashing termination reglet, produced from 6063-T5, 0.10inch.
  2. 0.12 inch thick extruded aluminum a 2-1/4 inch deep profile; provided in 10 foot lengths and with mitered inside and outside corners where walls intersect: Sarnafil Sarnareglet.
  3. Prefabricated outside and inside flashing corners made of 0.060 inch thick membrane heat-welded to membrane or base flashings: Sarnafil Sarnacorners – Universal.
  4. Reactivating-type adhesive used to attach membrane to flashing substrate: Sarnafil Stabond Adhesive.
  5. Non-woven polyester or polypropylene mat cushion layer used flashing membrane when the flashing substrates are rough or incompatible with the flashing membrane: Sarnafil Sarnafelt.

**2.03 COVER BOARDS**

- A. Cover Board: ASTM C1177, glass-mat, water-resistant gypsum substrate, match existing thickness.

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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. GP – Dens Deck Prime.

**2.04 WOOD BLOCKING**

- A. All nailers and blocking material to be free of wane, shake, decay or checks, and pressure treated with water-borne preservatives for above ground use, AWPA Standards U1, Use Category UC3b per Section 06 10 00.

**2.05 ATTACHMENT COMPONENTS**

- A. Membrane Adhesive.
  1. VOC compliant, low solvent-based reactivating-type adhesive used to attach the membrane to the substrate, either horizontally or vertically.
    - a. Sarnafil 2170 VC or 2121 Sarnacol Adhesive
- B. Factory- Recover Board Fasteners. coated steel fasteners, No. 12, and metal or plastic plates listed in FM "Approval Guide" designed for fastening recover boards to deck for Class 1-90 (high wind exposure).
- C. Termination Bars: Manufacturer's standard, flat aluminum termination bars, approximately 1 inch wide by 1/8 inch thick; with anchors. Aluminum shall be pre-punched with holes to allow various fastener spacing options.

**2.06 WALKWAYS**

- A. Membrane Walkway Protection:
  1. Crossgrip Walkway Mat; Sika Sarnifil
  2. Polyester reinforced, 0.096 inch (96 mil/2.4 mm), weldable membrane with surface embossment.
  3. Used as a protection layer from rooftop traffic.
  4. Rolls of 39.3 inches (1.0 m) wide and 32.8 feet (10 m) long.

**2.07 ROOF INSULATION**

- A. General: Preformed roof insulation boards approved by thermoplastic membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
  1. Approved Manufacturers:
    - a. Apache Products Company.
    - b. Atlas Roofing Corporation.
    - c. Celotex Corporation.
    - d. Firestone Building Products Company.
    - e. GAF Materials Corporation.
    - f. Johns Manville International, Inc.
    - g. Koppers Industries.
    - h. RMAX.

**2.08 TAPERED INSULATION**

- A. General: Preformed tapered insulation boards manufactured or approved by membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, and that produce FM Approvals-approved roof insulation.
- B. Tapered roof insulation shall be rigid polyisocyanurate foam insulation, with specially formulated organic/inorganic facers as manufactured by Dyplast Products Company, Celotex Building Products, or GAF.



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- C. The roof insulation shall provide 1/4 inch minimum per foot slope and provide minimum R30 insulation value. The tapered insulation shall consist of polyisocyanurate foam panels, chemically bonded during the foaming process to special organic/inorganic facers on the top and bottom surfaces.

**2.09 VAPOR BARRIER**

- A. Sarnavap Self-Adhered Vapor Barrier: 32 mil self-adhesive vapor barrier.
- B. Primer: Solvent-based primer designed for use with Sarnavap self-adhered vapor barrier to promote adhesion to most substrates.

**2.10 MISCELLANEOUS ACCESSORIES**

- A. Aluminum Tape: 2 inch wide pressure-sensitive aluminum tape.
- B. Sealing Tape Strip: Compressible foam with pressure-sensitive adhesive on one side.
- C. Multi-Purpose Tape: A high performance sealant tape used with metal flashings.
- D. Solvent Cleaner: Sarnafil Sarnasolv.
- E. All fasteners, anchors, nails, straps, bars, etc. shall be post-galvanized steel, aluminum or stainless steel.
  - 1. Assemble metal types and methods of contact in such a manner as to avoid galvanic corrosion.
  - 2. Fasteners for attachment of metal to masonry shall be expansion type fasteners with stainless steel pins.
  - 3. All concrete fasteners and anchors shall have a minimum embedment of 1-1/4 inch and shall be approved for such use by the fastener manufacturer.
  - 4. All miscellaneous wood fasteners and anchors used for flashings shall have a minimum embedment of 1 inch and shall be approved for such use by the fastener manufacturer.

**PART 3 – EXECUTION**

**3.01 ROOF PROTECTION**

- A. Protect existing roof membrane and rooftop appurtenances from damage during construction operations.
- B. Provide plank or plywood protection for wheeled or other traffic over existing building roof surfaces. Temporary protection shall be erected/installed at all interior and exterior locations as required to prevent damage to existing surfaces.
- C. 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.
- D. 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.

**3.02 PREPARATION**

- A. Protect existing membrane roofing system that is indicated not to be reroofed. Refer to Section 01 50 00 – Temporary Facilities and Controls for roof protection requirements in addition to those required in this section.
- B. Maintain the water-tightness of the existing finished building during the course of the new roofing work. Damages to the interior of the building or its contents due to new roofing work operations shall be repaired/restored/replaced at costs paid by the roofing installer.
- C. To permit the finished roofing surface to be used for traffic during installation of other equipment or accessories; all traffic and/or work areas shall be protected with 5/8-inch oriented strand board (OSB) or plywood. Ballast Protection Board with approved material (sandbags, etc.) to prevent blow-off. Protection board walkway shall be removed at the completion of all roof work.
  - 1. Limit traffic and material storage to areas of existing roofing membrane that have been protected.

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2. Maintain temporary protection and leave in place until replacement roofing has been completed.
- D. Coordinate with Owner to shut down air intake equipment in the vicinity of the Work. Cover air intake louvers before proceeding with roof modification work that could affect indoor air quality or activate smoke detectors in the ductwork.
- E. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- F. 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 will be 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.
- G. Verify that rooftop utilities and service piping have been shut off before commencing Work.

**3.03 MODIFICATION WORK**

- A. Carefully remove portions of existing roofing system down to structural deck as required for new work. Do not overcut or remove more of roofing system than necessary. Remove materials with care so as not to damage structural roofing substrate. Should existing work to remain be damaged, it shall be repaired or replaced as approved at no extra cost to the Owner.
- B. Remove the existing roofing and insulation systems as noted on the drawings to the top of the existing concrete decks. Remove all debris including loose insulation, fasteners, and all materials detrimental to the new work.
- C. Do not damage metal counterflashings, copings, etc. that are to remain. Replace metal damaged during removal with components of same metal, weight or thickness, and finish. Refer to same Section 07 62 00 for new sheet metal components.
- D. While existing roofing materials are removed during construction, protect exposed surfaces from weather. No work shall be performed during rainy or inclement weather which will affect quality of workmanship.
- E. Upon completion of new work by others (setting rooftop equipment), repair roofing system in accordance with manufacturer's details.

**3.04 DECK PREPARATION**

- A. Inspect deck after removal of membrane roofing system. Verify that concrete substrate is visibly dry and free of moisture.
  1. Test for capillary moisture by plastic sheet method according to ASTM D 4263 or by pouring 1 pint (0.5 L) of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane.
  2. Do not proceed with roofing work if moisture condenses under the plastic sheet or if asphalt test sample foams or can be easily and cleanly stripped after cooling.
- B. If deck surface is not suitable for receiving new roofing, or if structural integrity of deck is suspect, immediately notify Architect. Do not proceed with installation until directed by Architect.

**3.05 INFILL MATERIALS INSTALLATION**

- A. Immediately after removal of selected portions of existing membrane roofing system, and inspection and repair of deck, fill in the tear-off areas to match existing membrane roofing system construction.
  1. Installation of infill materials is specified in this section.
  2. Install new roofing membrane patch over roof infill area. If new roofing membrane is installed the same day tear-off is made, roofing membrane patch is not required.

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**3.06 INSTALLATION, GENERAL**

- A. Install tapered insulation over repair areas of roofing if required to conform to slope indicated and in accordance with manufacturer's instructions.
- B. Extend insulation full thickness in two layers or as required to match thickness of existing insulation. Install in accordance with insulation manufacturer's instructions. Lay insulation boards to moderate contact without forcing joints. Stagger joints in one direction for each course. Cut insulation to fit neatly to perimeter blocking and protrusions through roof. Do not install more insulation each day than can be covered with membrane before end of day and before start of inclement weather.
- C. Install tapered insulation where noted or required to provide slopes, tapers, and positive drainage within the finished roof system.
- D. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA.
- E. Install roofing membrane sheets so side and end laps shed water.
- F. Coordinate the installation of insulation, roofing membrane, and flashing so that insulation is not exposed to precipitation nor exposed overnight.
- G. Existing materials shall be legally removed and properly disposed of off the site. No burning of existing material or debris shall be allowed on the site.

**3.07 EQUIPMENT CURBS**

- A. Inspect and verify that all curbs are properly secured to deck, are level, a minimum 8 inches above finished roof, primed and ready to receive roofing flashings.
- B. Membrane is to run horizontally tight up against the vertical curb as required.
  - 1. When membrane is to act as temporary seal for an extended length of time, carry membrane up vertical surface a minimum of 1-inch.
- C. Install equipment curb flashing as follows:
  - 1. Pre-cut flashing to the total sum of curb height plus 6-inches for base tie-in with width to match that of curb plus 3-inch overlap at each end.
  - 2. Apply PVC bonding adhesive to walls and top of the curb for adhering flashing membrane.
  - 3. Cut membrane to conform to curb dimensions.
  - 4. Place membrane and roll membrane to secure to substrate surfaces.
  - 5. Weld the base flashing to horizontal deck membrane. Weld vertical overlaps.
  - 6.
- D. Extend flashing up vertical surfaces a minimum of 8 inches above roofing membrane or as shown in drawing details, and minimum 4 inches onto field of roofing membrane.
- E. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

**3.08 FIELD QUALITY CONTROL**

- A. Upon completion of the Work and prior to final payment, the roofing system manufacturer's representative, in the presence of the Architect, shall observe the work. Discrepancies shall be recorded and immediately rectified. Final payment will not be issued until the manufacturer's representative has given his approval for the Work.
- B. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

**3.09 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.

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- 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 spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

**3.10 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.

**END OF SECTION**

**SECTION 07 42 13**  
**COMPOSITE METAL WALL PANEL ENCLOSURE**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section includes metal-faced composite wall panel enclosure system and attachment systems
  - 1. Note: Configuration of enclosure required close coordination with new HVAC Piping and installation and routing on lines on the exterior face of the building.
- B. Related Sections:
  - 1. Section 07 62 00 – Sheet Metal Flashing: for copings, flashings, and other sheet metal work not part of metal wall panel assemblies.
  - 2. Section 07 92 00 – Joint Sealants for field-applied sealants not otherwise specified in this Section.
  - 3. Division 23 specification sections.

**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. of wall area when tested according to ASTM E 283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 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. Other Design Loads: As indicated on Drawings.
  - 3. 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): minus 20 deg F to 180 deg F material surfaces.

**1.04 ACTION SUBMITTALS**

- A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures.

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- 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. Take accurate field measurements from installed piping.
  - 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.
  - 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.
- 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. Z-girts and clips
  - 3. Wall-mounted items.
  - 4. Penetrations and enclosure 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 metal-faced composite wall panels from single source from single manufacturer.
- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by MCM Fabricator.

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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.
- 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.
  2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**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 adjoining work to provide a leakproof, secure, and noncorrosive installation.

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**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: Five 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-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 METAL-FACED COMPOSITE (MCM) WALL 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 thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight system.
  - 1. Basis-of-Design Product:
    - a. ALUCOBOND®; 3A Composites USA Inc.;
  - 2. Subject to compliance with requirements, acceptable products include the following:
    - a. Reynobond, Arconic Architectural Products
    - b. ALPOLIC Materials.
- B. Aluminum-Faced Composite Wall Panels. Formed with 0.020-inch- thick, coil- aluminum sheet facings with finishes as noted below:
  - 1. Panel Thickness: 0.517 inch
  - 2. Core: Standard.
- B. Attach Peel Strength: 22.5 in-lb/in. when tested for bond integrity in accordance with ASTM D1781.
- C. Fire Performance: Flame spread less than 25 and smoke developed less than 450, in accordance with ASTM E84.
- C. 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. Surface: Smooth, flat finish.
  - 2. Exposed Coil-Coated Finishes:
    - a. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat,



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and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. 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.

**2.03 MISCELLANEOUS METAL FRAMING**

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide Fabricator's standard sections as required for support and alignment of MCM panel system.
- B. Zee Clips: 0.079-inch nominal thickness.
- C. Base or Sill Angles: 0.079-inch nominal thickness.
- D. Fasteners for attachment to existing construction: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten to existing 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: Finish flashing and trim with same finish system as adjacent metal-faced composite wall panels. 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.
  1. Aluminum Trim: Formed with 0.040-inch thick, coil-coated aluminum sheet facings.
  2. Color: As selected by Architect from manufacturer's full range.
- C. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of MCM panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

**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 MCM 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.
- C. 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.

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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 Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations or 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 non-expansion, but movable, joints in metal to accommodate sealant and 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 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.

**2.07 GENERAL FINISH REQUIREMENTS**

- 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. Composite Panels and Accessories:
  1. PVDF 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.
  2. Note: Color and finish are to match existing panels on building.
    - a. (Contractor Verify) Color and Gloss: Kawneer Permadize "Sterling Gray (789G018).

**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 barrier has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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- 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. Anchor 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-faced composite wall panels.
  - 2. Flash and seal metal-faced composite wall panels at perimeter of all openings..
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as MCM 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 MCM panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Aluminum Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior.
- 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. Attachment System Installation, General: Install attachment system required to support metal- faced composite wall panels and to provide a complete weathertight wall system.
  - 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- E. 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.

**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.

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**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 FIELD QUALITY CONTROL**

- A. Fabricator's Field Service: Engage a factory-authorized service representative to test and inspect completed MCM wall panel installation, including accessories.
- B. MCM wall panels will be considered defective if they do not pass test and inspections.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

**3.07 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 62 00**  
**SHEET METAL FLASHING**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section includes providing sheet metal for the following applications:
  - 1. Flashings used in conjunction with installation of roof curbs on roofing system sheet membrane base flashings.
  - 2. 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 01 50 – Existing Roofing Modifications
  - 3. 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 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.

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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.

**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: Coordinate with roofing modification 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.

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**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 as required for a complete system and as recommended by sheet metal manufacturer and fabricator for metal work, unless otherwise indicated.
- C. 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.
- D. Metal Accessories: Provide cleats, straps, anchoring devices, and similar accessory units as required 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.

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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 1/2-inch (13-mm); miter and seam corners.
  3. Fabricate vertical faces with bottom edge formed outward 1/4-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.



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2. Apply underlayment membrane 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. Where metal flashing is installed over wood-preserved-treated lumber, install continuous waterproof or felt underlayment as a separator between wood and flashing.
- C. Install sheet metal flashing true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- D. 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 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 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, and latex joint sealants.
- B. Related Sections:
  - 1. Section 07 84 00 – Firestopping.
  - 2. Section 09 29 00 – Gypsum Board for acoustical joint sealants.

**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. 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.
- B. 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.
- C. High Performance Building Submittals:
  - 1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.
  - 2. Laboratory Test Reports for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- 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.

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- 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 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.

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- C. Do not install solvent curing sealants in unventilated building spaces.

**1.08 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.
- 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.

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- 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. 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  $\pm 50$  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  $\pm 50$  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.

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- d. Color: [Match Architect's custom 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"

**2.04 URETHANE JOINT SEALANTS**

- A. 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  $\pm 35$  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"

**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 Sheetrock Acoustical Sealant"
  3. Pecora, product " AIS-919"
  4. GE product "Acoustical Sealant 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  $\pm 12.5$  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 SM** (Silicone, Mildew-resistant): One-part. ASTM C 920, Type S, Grade NS, Class 50, for use NT, minimum movement capability of  $\pm 50$  percent, and a Shore A hardness of 20, equal to the following:
  1. Master Builders "MasterSeal NP 150"
  2. Dow Dowsil "786 Mildew-resistant"
  3. GE Silicones "SCS1700 Sanitary"
  4. Tremco, "Tremsil 200 Sanitary"
  5. Pecora, "898NST"

**2.07 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.

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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 "SOF Rod"
  2. Industrial Thermo Polymers Ltd., Brampton, Ontario CN, "ITP Standard Backer Rod"
  3. Master Builders "MasterSeal 920"
  4. W.R. Meadows Inc., Hampshire, IL, "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. Master Builders 921.
- 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.

**2.08 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.

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- 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 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.

**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.



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**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 joints, seams, and intersections between dissimilar materials.

- B. Sealant Colors:

- 1. Colors for Sealant Types “SC” and “SM”: As selected by the Architect from manufacturer’s standard colors.
- 2. Color for Sealant Types “AA” and “AP”: White.
- 3. In concealed installation, and in partially or fully exposed installation where so approved by the Architect, standard gray or black sealant may be used.

- C. Specialty Joint Conditions:

- 1. Sealing termination bars and through-wall flashing in cavity walls: Sealant type: PE.

- D. 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
Precast concrete to abutting materials (vertical joints)	P1

- 2. Exterior Masonry:

JOINT CONDITION	SEALANT TYPE
Masonry to abutting non-porous materials (painted metals, anodized aluminum, mill finished aluminum, PVC, glass, and similar materials):	SE or ST
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

- E.

- F. Interior joints (Listed by primary building material abutting sealant joints):

- 1. Interior Masonry: \* Includes interior side of exterior masonry walls

JOINT CONDITION	SEALANT TYPE
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

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2. 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

**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. Metal studs for partition framing as indicated for interior partitions.
- B. Related Sections:
  - 1. Section 09 29 00 – Gypsum Board

**1.02 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.
- C. Product Test Reports: Submit laboratory tests certifying STC ratings for acoustically rated partitions as indicated.
- D. Allowable Installation Tolerances: Provide framing to conform with the following allowable tolerances:
  - 1. Partition Framing Location: Within plus or minus 1/4-inch of required locations.
  - 2. Partition Framing Members: Plumb within plus or minus 1/8 inch from the plane formed by faces of adjacent framing.

**1.03 QUALITY ASSURANCE**

- A. 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.
- 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. 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-

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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).

**1.04 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".

**PART 2 – PRODUCTS**

**2.01 MANUFACTURERS**

- A. Steel Framing: Subject to compliance with requirements, provide products by one of the following:
  1. Clark/Dietrich, West Chester, OH.
  2. MarinoWARE, South Plainfield, NJ.
  3. Steel Network Inc. (The), Raleigh, NC.

**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 0.0296inch (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. Partitions Supporting Wall Mounted Casework: 0.0538 inch (16 gauge) minimum base metal thickness.
  6. Member Description: ProSTUD 20 (20ga equivalent drywall stud) 70ksi.

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- 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.

**2.03 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.

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- 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.

**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. 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."
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.
- F. Install framing members to preclude direct physical contact with conduits, pipe, and ducts; coordinate with installation of sleeves for mechanical penetrations.
- G. Erect framing in true planes to provide solid backing for finish materials; tolerance limitations are specified under the various finishes unless noted herein.
- H. 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. 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.
- B. 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.
- C. Install studs so flanges within framing system point in same direction.
  - 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.
- 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.

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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. 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.
- G. 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.
- H. 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.
- I. Miscellaneous Assemblies: Provide framing for elements shown on the drawings in accordance with approved drawings and standards of practice indicated.
- J. 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.
- K. 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 RESILIENT FURRING**

- A. Comply with provisions of the Gypsum Construction Handbook "Chapter 3 Cladding" and "Resilient Board Application."
- B. Resilient Channels: Install resilient channels on wood or metal-framed walls. Attach resilient channels with the attachment flange down, except at floor level, install face up and at right angles to the wall studs.
- C. For walls, install resilient channels at right angles to studs or joists, using 9.5-mm (3/8-in.) type S pan head screws.
- D. Where resilient channel must be overlapped, splicing is necessary. Nest the ends of the channel directly over the framing members at the proper spacing, to align the pre-punched holes.
- E. When fastening resilient channel, drive screws into the channels between the studs or joists. The appropriate length of screw must be selected, and the location of the studs or joists identified, before attachment of the wallboard. Screwing the wallboard through the channel to the stud or joist destroys the 'spring' assembly that suspends it.

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- F. Hold back ends of resilient channels from the side walls to eliminate binding against the wall. Ends should also be held off the top and bottom of a wall by a distance of 100 to 150 mm (4 to 6 in.). Where baseboard is used, screws cannot rigidly attach the base of the wall to the sill plate. Similarly, at the top of the wall, gypsum wallboard cannot be attached to the header.
- G. Where a wall meets a resilient ceiling, maintain a 6-mm (¼-in.) gap to prevent supporting of the ceiling and grounding of the resilient channel. This gap should be filled with resilient caulk, and finish-taped.
- H. Penetrations in a ceiling or wall assembly require maintaining the performance of the resilient channel and the integrity of the assembly's sound transmission performance. Where lighting is attached to joists, allow a 6-mm (¼-in.) gap on the perimeter. Seal gap with resilient sealant.

**END OF SECTION**



**SECTION 09 29 00**  
**GYPSUM BOARD**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section Includes: Interior gypsum board faced walls, partition assemblies, and supplementary items necessary for installation as follows.
  - 1. Repair work at existing gypsum board assemblies.
- B. Related Sections:
  - 1. Section 09 22 16 – Non-Structural Metal Framing: Wall framing
  - 2. 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.

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**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 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.

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- 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.

**1.08 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.

**1.09 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.

**1.10 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. *Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Provide products from one of the named manufacturers below.*
- B. 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:

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1. Manufacturers:
  - a. United States Gypsum Company (USG)
  - b. National Gypsum Company, LLC
  - c. CertainTeed Gypsum Corp
  - d. Georgia-Pacific Gypsum
- C. 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:

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- 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 DensArmor Plus Fireguard Abuse-Resistant Interior Panels.

**2.04 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. Phillips Manufacturing.
    - c. 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.

**2.05 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.

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- D. Miscellaneous Fasteners: For conditions not indicated, fasteners shall be type, finish, size, and holding power recommended by respective gypsum board manufacturer and conditions.

**2.06 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.
- 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.
- 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.

**2.07 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. 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
- D. 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.

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**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. 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 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.
- 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.

**3.04 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

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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.

**3.05 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. 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.
- D. 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.

**3.06 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. 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.
- C. 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.
- D. 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.



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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 to receive firestopping.
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 to receive firestopping.
9. Support both edge and end joints of gypsum boards over metal framing.

**E. 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 as recommended by installation quality standards.
4. Space screws for fire resistance rated partitions as required by assembly fire test reports.
5. Start field screwing near center and work towards edges.
6. Space screws not less than 3/8 in (10 mm) from gypsum boards edges.
7. Do not attach gypsum boards to top runner where wall or partition extends to building structure unless required by fire test reports.

**3.07 INSTALLING TRIM ACCESSORIES**

- A. Attach trim according to manufacturer's written instructions.
- B. 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.
- C. Exterior Trim:
  1. Cornerbead: Use at outside corners.
  2. LC-Bead: Use at exposed panel edges.
- D. Cornerbead: Install in single pieces at vertical corners.

**3.08 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 indicated in schedule at end of section.

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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.

**3.09 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.

**3.10 PROTECTION**

- A. Procedures: Protect products and systems from damage during installation and remainder of construction period according to manufacturer’s instructions.

**3.11 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:
    - a. Paint and Wall Coverings Only: Typical paper-faced gypsum board.
  2. Abuse-resistant walls as indicated in the Drawings:
    - a. Paint and Wall Coverings Only: Abuse-resistant paper-faced gypsum board.

**3.12 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 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.
- E. 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.

**END OF SECTION**

**SECTION 09 51 13**  
**REMOVAL AND RE-INSTALLATION OF ACOUSTICAL PANEL CEILINGS**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section includes installation of salvaged acoustical panels and installation of new exposed suspension systems for interior ceilings.

**1.02 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.03 ACTION SUBMITTALS**

- A. Samples: For each exposed product and for each color and texture specified.
- B. Delegated-Design Submittal: For seismic restraints for ceiling systems.
  - 1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Product test reports.
- C. Research reports.
- D. Field quality-control reports.

**1.05 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**PART 2 – PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

**2.02 ACOUSTICAL PANELS**

- A. Install salvaged acoustical panels in existing suspension system.

**2.03 NEW METAL SUSPENSION SYSTEM**

- A. Match existing suspension system which was removed.
- B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M.
- C. 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.

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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.

**2.04 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.
- B. Hold-Down Clips: Manufacturer's standard hold-down.
- C. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

**2.05 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 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.

**3.02 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.

**3.03 STORAGE**

- A. 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.
- B. All products must be stored in a interior space and not exterior space.
- C. 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.
- D. Store pairs of panels face to face.

**3.04 RE-INSTALLATION**

- 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. Arrange acoustical units and orient directionally patterned units (if any) in manner shown by reflected ceiling plans.
- C. Install tile with pattern matching original installation.
- D. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
- E. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

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1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
3. Arrange directionally patterned acoustical panels as follows:
  - a. Match pattern of removed acoustical panel ceilings.
4. Install seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.

**3.05 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified special inspector to perform inspections.
  1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

**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.

**END OF SECTION**

**SECTION 09 67 23**  
**SEAMLESS RESINOUS FLOORING**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Seamless resinous (epoxy) trowel applied flooring with integral cove base, including, non-slip surface, surface and crack preparation for identified mechanical rooms.
- B. Related Sections:
  - 1. Section 02 41 19 – Selective Demolition for existing resilient flooring.

**1.02 PERFORMANCE REQUIREMENTS**

- A. Provide epoxy flooring with a finish surface that has a Static Coefficient of Friction minimum of 0.06 when tested in accordance with ASTM C 1028.

**1.03 PREINSTALLATION MEETING**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review manufacturer's written instructions for substrate preparation and environmental conditions affecting resinous flooring installation.
  - 2. Review concrete substrate requirements for conditions affecting performance of flooring, including results of moisture and alkalinity tests.
    - a. Review locations and frequency of moisture and alkalinity tests.
  - 3. Review details of integral cove bases.
  - 4. Review manufacturer's written instructions for installing resinous flooring systems.
  - 5. Review protection measures for adjacent construction and installed flooring, floor drainage requirements, curbs, base details, and so forth.

**1.04 ACTION SUBMITTALS**

- A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Manufacturer's Product Data: Materials description, installation instructions and specifications and maintenance instructions for materials used in the installation.
- C. Samples:
  - 1. 12 inch x 12 inch samples of resin flooring on 1/4 inch thick tempered hardboard including waterproofing membrane and non-slip surface.
  - 2. Samples for Color Selection Verification: Manufacturer's standard full range color samples for selection by the Architect verification of specified color.
- D. Warranty: signed copies of warranty in form and terms specified.

**1.05 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Material Certificates: For each resinous flooring component.
- C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.
- D. Test Reports: From Testing Agency for pre-installation substrate moisture and alkalinity tests.
- E. Field quality-control reports.

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**1.06 QUALITY ASSURANCE**

- A. Material Source Limitations: Provide materials and methods of installation in accordance with the current printed instructions and specifications of the Resinous Flooring Manufacturer except as hereafter modified and as approved by the Resin Flooring Manufacturer.
- B. Installer Qualifications: The Resinous Flooring Installer is to be approved and certified by the Resinous Flooring Manufacturer and is to provide evidence of same to the Architect upon request.
- C. Manufacturer's Responsibilities: The manufacturer of the resinous flooring is to provide a representative to inspect and verify that the conditions of the proposed installation are in compliance with the manufacturer's requirements prior to installation of materials. The manufacturer's representative is to also inspect the installation during application and upon completion of the resinous flooring materials to ascertain and verify the resinous flooring has been installed in accordance with the manufacturer's printed installation instructions and this specification and to assist in the quality assurance and quality control process of the installation to perform field problem solving issues with the installer if required.
- D. Installer Responsibilities: The Installing Contractor and Resinous Flooring System Manufacturer are to review the proposed installation and the Contract Documents. The Installing Contractor is to include in the work in addition to that shown on the Drawings and specified herein all additional work required the Resinous Flooring System Manufacturer at no additional cost to the Owner as required for a complete warranted resinous flooring system.

**1.07 MOCK-UP INSTALLATION**

- A. Before installing resinous flooring construct a mock-up to verify aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for completed Work.
  - 1. Locate mockups in the location indicated on the Drawings or by the Architect. Provide not less than a 8 foot x 8 foot mock-up. Include 8 foot length of integral cove base with inside corner.
  - 2. Notify Architect 7 days in advance of the dates and times when mockups will be constructed. Notify Architect when mock-up is complete and ready for review.
- B. Make changes or corrections to the mock-up as directed by the Architect. After final review of the mock-up, it may be incorporated to the work.
- C. The final reviewed mock-up will be used as a standard of quality and workmanship for the remainder of the resinous flooring installation. Approval of mockups does not constitute approval of deviations from Contract Documents contained in mockups, unless such deviations are specifically approved by Architect in writing.

**1.08 DELIVERY, STORAGE AND HANDLING**

- A. Deliver materials in manufacturer's unopened containers identified to show name, brand, mixing and application instructions.
- B. Store and protect containers from damage. Immediately removed from the job site damaged or otherwise unsuitable materials when so ascertained.
- C. Storage area temperature is not to be below 50 degrees not exceed 90 degrees F.

**1.09 PROJECT/SITE CONDITIONS**

- A. Verify that concrete surfaces, atmospheric and flooring materials are not lower than 50 degrees F. Verify that surfaces are clean and dry prior to application.
- B. Provide temporary protection (polyethylene sheets or strippable masking) to areas, finishes and elements of the building that would be damaged by contact with membrane and flooring materials.

**1.10 WARRANTY**

- A. The Resinous Flooring Manufacturer is to warrantee in writing the resin flooring and waterproofing membrane to be free of faults and defects in accordance with the General Conditions, for one (1) year.

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- B. The warranty is to cover both labor and materials required to repair defective areas and areas in which moisture has penetrated structurally sound materials.
- C. Provide warranty in writing and signed by the Resin Flooring Membrane Manufacturer and Installer. Submit signed copies to the Architect.
- D. This warranty is in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

**PART 2 – PRODUCTS**

**2.01 MANUFACTURER/PRODUCT**

- A. Acceptable Manufacturers:
  - 1. Basis of Design: Sherwin-Williams Company
  - 2. Crossfield Products Corp.
  - 3. Duraflex, Inc.
- B. Basis of Design Manufacturer/Product: The Sherwin Williams Company, Cleveland, OH Resufloor Topfloor MER II with Epoxy Cove.
  - 1. Prime vertical surfaces with 3561V and maintain tackiness.
  - 2. Combine sand and 3561V to trowel cove up to desired height.
  - 3. 1<sup>st</sup> Coat: Primer Resuprime 3579 applied at 250 sq. ft./gal
  - 4. 2<sup>nd</sup> Coat: First base coat Resufloor 3555 applied at 80 sq. ft. / gal.
  - 5. 3<sup>rd</sup> Coat: Wearcourse Resufloor 3555 applied at 130 sq. ft. / gal. and broadcast with Broadcast 5310-8 Dry Silica Sand (20-40 mesh) or Other Hard Aggregate at 0.4 lbs/sq ft
  - 6. 4<sup>th</sup> Coat: Grout Coat Resufloor 3746 applied at 80 sq. ft./gal
  - 7. 5<sup>th</sup> Coat: Topcoat Resufloor 3746 applied at 100-150 sq. ft./gal
  - 8. Total system thickness: 100-120 mils
- C. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.
- D. High-Performance Resinous Flooring:
  - 1. Resinous Flooring: Abrasion-, impact- and chemical-resistant, high-performance, resin-based, monolithic floor surfacing designed to produce a seamless floor.
  - 2. System Characteristics:
    - a. Color: As Selected by Architect.
    - b. Slip Resistance: Provide slip resistant finish.

**2.02 MATERIALS**

- A. VOC Content of Resinous Flooring: Provide resinous flooring systems, for use inside the weatherproofing system, that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
  - 1. Resinous Flooring: 100 g/L.

**PART 3 – EXECUTION**

**3.01 EXISTING FLOORING**

- A. Remove resilient flooring in preparation of first grind [95% of mastic should be removed; concrete should be grey). If black mastic is present, verify asbestos report before continuing. Ensures areas of existing resilient flooring have been removed 12 to 14 days prior to start of resinous flooring in order to perform job walk with resinous flooring manufacturer representative to evaluate floor condition, such as the need to fill joints and patch.



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**3.02 PREPARATION**

- A. Inspection: Prior to commencing Work, thoroughly examine all underlying and adjoining work, surfaces and conditions upon which Work is in any way dependent for perfect results. Report all conditions which affect Work. No "waiver of responsibility" for incomplete, inadequate or defective underlying and adjoining work, surfaces and conditions will be considered, unless notice of such unsatisfactory conditions has been filed and agreed to in writing before Work begins. Commencement of Work constitutes acceptance of surfaces.
- B. Surface Preparation: Remove all surface contamination, loose or weakly adherent particles, laitance, grease, oil, curing compounds, paint, dust and debris by blast track method or approved mechanical means (acid etch not allowed). If surface is questionable try a test patch. Create a minimum surface profile for the system specified in accordance with the methods described in ICRI No. 03732 to achieve profile CSP 3-5 as follows:
  - 1. Thin film, to 10 mils CSP-1 to CSP-3
  - 2. Thin and medium films, 10 to 40 mils CSP-3 to CSP-5
  - 3. Self-leveling mortars, to 3/16" CSP-4 to CSP-6
  - 4. Mortars and laminates, to 1/4" or more CSP-5 to CSP-10
- C. Remove all dust, dirt, loose material, curing compounds, sealers, hardeners, oil, grease, paint, adhesives, and other foreign matter which will affect the application of primer and floor coating.
  - 1. Remove dust and debris by vacuuming in accordance with ASTM D 4258. Repeat vacuuming operation a second time before coating application.
  - 2. Just prior to application of coating rub the dry floor with a black cloth to check for signs of dust. If dust is present, vacuum the floor until free from dust.
- D. Before installing seamless flooring, fill all cracks and holes and level depressions with materials recommended by flooring manufacturer.
- E. Application of materials constitutes acceptance of existing conditions and surface materials.
- F. Maintain spaces to receive waterproofing membrane and flooring materials at a minimum temperature of 70 degrees F.; maintain temperature during installation and curing of materials.
- G. Surfaces to receive seamless flooring and waterproofing membrane are to meet the minimum requirement of the manufacturer of the seamless flooring. Application or installation of materials constitutes acceptance of the substrates.
- H. Do not start seamless flooring work until permanent equipment and all items that go through the seamless flooring and waterproofing membrane have been installed.
- I. Close spaces in which seamless flooring is being installed to traffic or other work.

**3.03 TESTING**

- A. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- B. Test for Moisture: Perform both of the following tests as required by the flooring material manufacturer to determine the manufacturer's acceptable floor slab moisture before installation.
  - 1. Calcium Chloride Test: Perform anhydrous calcium chloride test per 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. Perform tests so that each test area does not exceed 1000 sq. ft. and perform 3 tests for the first 1000 sq. ft. and one additional test for every additional 1000 sq ft.
  - 2. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative-humidity-level measurement.

**3.04 APPLICATION**

- A. Install resinous floor over properly prepared concrete surface in strict accordance with the manufacturer's directions.
  - 1. Install the primer and/or base coats over thoroughly cleaned and prepared concrete.

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2. Install topcoat over flooring after excess aggregate has been removed.
  3. Maintain a slab temperature of 60°F to 80°F for 24 hours minimum before applying floor topping, or as instructed by manufacturer.
- B. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- C. Crack Repair: Prepare and fill cracks and joints in concrete floor slabs with materials recommended by and installed in accordance with the flooring system manufacturer's printed installation instructions.
- D. Mixing: Mix materials in accordance with label instructions prior to application. Apply materials using manufacturer's approved tools and equipment.
- E. Flooring: Trowel apply seamless flooring to a no lap uniform minimum 1/8 inch thickness. Apply fill-in coat or coats to produce a smooth uniform surface. Fill in cracks appearing in the flooring and base after curing period.
- F. Cove Base: Install integral cove base the same thickness as flooring to height shown on the Drawings. If not shown, install four inches high above finish floor. Finish and fill-in base same as flooring.
- G. Non-slip Topping Coating: Trowel apply non-slip topping to seamless flooring surfaces to produce a finish uniform in color and texture.

**3.05 CLEANING AND PROTECTION**

- A. Clean seamless flooring and cove base with cleaner recommended by the Seamless Flooring Manufacturer, in accordance with flooring manufacturer's printed instructions.
- B. Cover seamless flooring with non-staining building paper or polyethylene sheeting until just prior to occupancy by the Owner. Cover areas used as walkways during construction with plywood boards in addition to other coverings.
- C. Instruct Owner's maintenance personnel in the cleaning and maintenance of seamless flooring.

**END OF SECTION**

SECTION 20 05 01 - INTRODUCTORY STATEMENT

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of Instructions to Bidders, General Conditions, and Division 1 apply to all work herein.
- B. In addition to conforming to the documents listed in Paragraph A above, the work performed by the Plumbing, Fire Protection, and Heating, Ventilating and Air Conditioning (HVAC) Contractors shall conform to all provisions of Sections 20 00 00 through 20 99 99 as included in this Specification. The Plumbing, Fire Protection, and Heating, Ventilating and Air Conditioning Contractors are each to consider the word "Contractor" when used in these Sections to mean themselves.
- C. All Plumbing, Fire Protection, and Heating, Ventilating and Air Conditioning Contractors must read the entire Specification and all divisions therein because they will be responsible for Work described in other Sections where reference is made to "Mechanical Contractor" or other commonly used terminology that implies the Plumbing Contractor, Fire Protection Contractor, or Heating, Ventilating and Air Conditioning Contractor.
- D. Plumbing Contractor shall provide temporary water, unless otherwise assigned in Division 1. Heating, Ventilating and Air Conditioning Contractor shall provide temporary heat, unless otherwise assigned in Division 1.
- E. All work included under this heading is subject to the Bidding Requirements, General Conditions, and Division 1 General Requirements written for this entire Specification, whether attached to this Part or not, and the Contractor is notified to refer thereto as an integral part of the work.

1.02 APPLICABLE SECTIONS

- A. Contractors shall perform work described in the preceding paragraphs, the General Conditions, Division 1 and in the following Sections (as included):
  - 1. Fire Protection: Sections 20 00 00 through 20 99 99  
Sections 21 00 00 through 21 99 99
  - 2. Plumbing: Sections 20 00 00 through 20 99 99  
Sections 22 00 00 through 22 99 99
  - 3. HVAC: Sections 20 00 00 through 20 99 99  
Sections 23 00 00 through 23 99 99
- B. Contractors are required to coordinate their work with that described in other Sections, and therefore, must familiarize themselves with the entire set of Specifications.

1.03 RESPONSIBILITY

- A. The Engineer's efforts under this contract are aimed at designing a project that will be safe after full completion. The Engineer has no expertise in, and assumes no responsibility for, construction means and methods, nor job site safety during construction. These are exclusively the Contractor's responsibility. The Engineer may process or approve Contractor submitted means or methods that may contain information related to construction methods or safety issues. The Engineer may also participate in meetings where such issues might be discussed. Such processing or participation shall not be construed as voluntary assumption by the Engineer of any responsibility for safety procedures.

END OF SECTION

SECTION 20 05 05 - PLUMBING, FIRE PROTECTION, AND HVAC GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish all materials, labor, tools, and equipment to complete and leave ready for operation all Fire Protection, Plumbing and Heating, Ventilating and Air Conditioning (HVAC) systems.
- B. By submitting a Bid, the Contractor certifies that:
  - 1. The Contractor has visited the site and is satisfied that he/she understands all site conditions that may affect his/her Bid price, with the sole exception of those items which he/she specifically is taking exception to in writing in his/her Bid.
  - 2. The Contractor fully understands the make-up, construction, and operation of all systems and equipment he/she is bidding on and has included in his/her price all materials, supplies, accessories, and services necessary to make these systems complete and operational, whether such materials, supplies, and services are explicitly shown on the Drawings or included in these Specifications or only implied by the clear intent of these Documents that the Contractor provide a complete and fully operational system as part of the scope of work undertaken by this Contractor.
- C. These General Requirements are in addition to the other requirements referenced elsewhere within these Specifications.

1.02 ENVIRONMENTAL GUIDELINES

- A. Comply with all Project Requirements in Division 01 for Construction Waste Management.
- B. Minimize the use of virgin materials and minimize waste during construction.
- C. Use low-VOC mastics and sealants.

1.03 STANDARDS OF QUALITY

- A. Provide quality work conforming to the best accepted practice and standards of the trade. Further definition of quality is given by reference to various laws, codes, standards, and regulations.
- B. All laws and codes having jurisdiction over this project are deemed to be included in their entirety as a part of these Specifications. Also, any other laws, codes, standards, or regulations referenced herein are deemed to be included in their entirety.
- C. If a conflict occurs between the Drawings, the Specifications, and the applicable codes, immediately call the conflict to the attention of the Architect before bids are submitted. The Architect will determine which interpretation shall take precedence. Conflicts not brought to the Architect's attention before bids are due shall be priced by the Contractor to include the most expensive, highest quality alternative.

- D. Material and equipment installed under this Contract shall be new, undeteriorated, and of a quality not less than the minimum specified. All equipment shall be certified, listed, and labeled by UL. If UL does not certify an associated piece of equipment, then certification by another nationally recognized testing laboratory such as CTL shall be permissible. If equipment is of a type that no testing lab lists nor labels, then a safety evaluation must be performed at the supplier's expense by the inspecting authority or another federal, state, or municipal agency.
- E. The following codes apply to this work (as approved and amended by the Authority Having Jurisdiction including all applicable sections of interim agreements in effect at the time of permit issuance):
1. Local
    - a. Building Code
    - b. Fire Code
  2. State of Ohio
    - a. Ohio Building Code
    - b. Energy Conservation Code
    - c. Mechanical Code
    - d. Plumbing Code
    - e. Pressure Piping Code
    - f. Fire Code
  3. National
    - a. National Fire Protection Association (NFPA) Codes as listed in subsequent Sections and Article 101
    - b. Power Piping ASME B31.1
    - c. Refrigeration Piping ASME B31.1
    - d. International Fuel Gas Code (IFGC)
    - e. All applicable OSHA Requirements
    - f. All applicable EPA Requirements
    - g. Industrial Risk Insurers (IRI)
- F. Work must be performed by licensed Contractors as required by Local and State Codes.
- G. Methods and materials must be certified where noted in the individual Specification Sections.
- H. All equipment and appliances must bear a tag or label of an Approved Testing Agency. Review Local Code requirements.
- I. Work must comply with City of Columbus, Ohio, Ohio Building, Mechanical, Plumbing, and Fire Codes. Unless otherwise noted, the latest enforced code edition shall apply to this work.
- J. If the hardware or software installed under this Contract interacts with any existing systems that do not already have this feature, this Contractor is to notify the Owner, in writing and in a timely manner, of the specific changes that the Owner must make to the existing systems to bring the combined system into compliance with this requirement.

#### 1.04 CONTRACT DRAWINGS

- A. Drawings are schematic and show approximate locations and extent of work. Exact locations and extents must be coordinated with other Contractors and verified in the field. Coordination of the final fabrication drawings and final coordination of the installation in the field is the Contractor's responsibility. The Contractor is to take the design to the next level of detail, knowing exactly what equipment and materials he/she is going to provide, and build the project on the basis of that equipment and other approved Shop Drawings.
- B. The Drawings indicate required size and points of termination of pipes and ducts and suggests proper routes to conform to structure, avoid obstructions, and preserve clearances. However, it is not intended that Drawings indicate all necessary offsets, and the Contractor shall, without further instructions or additional cost to the Owner, make the installation in such a manner as to conform to structure, avoid obstructions, preserve headroom, and keep openings and passageways clear.
- C. When the work as indicated on the Contract Drawings exceeds the minimum required by any code, standard, requirement, rule, or regulation, the Contract Drawings shall govern the design and installation of the work.
- D. Significant deviations from Drawings must be approved by the Architect.
- E. Up to the time of roughing in, the Architect reserves the right to make minor changes in location that do not require additional labor or material. No cost shall be added to the Contract for a minor change. The Architect shall determine what is a "significant" and what is a "minor" change.

#### 1.05 ABBREVIATIONS AND SYMBOLS

- A. Listed below are titles and abbreviations used in the Specification. All may not necessarily apply to this work.
  - 1. AABC Associated Air Balance Council
  - 2. ADA Americans with Disabilities Act
  - 3. ADC Air Diffusion Council
  - 4. AGA American Gas Association
  - 5. AMCA Air Movement and Control Association
  - 6. ANSI American National Standards Institute
  - 7. ARI Air Conditioning and Refrigeration Institute
  - 8. ASA Acoustical Society of America
  - 9. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
  - 10. ASME American Society of Mechanical Engineers
  - 11. ASSE American Society of Sanitary Engineers
  - 12. ASTM American Society for Testing and Materials
  - 13. AWWA American Water Works Association
  - 14. BAS Building Automation System
  - 15. CGA Compressed Gas Association
  - 16. CISPI Cast Iron Soil Pipe Institute
  - 17. EJMA Expansion Joint Manufacturers Association, Inc.

18. EPA	Environmental Protection Agency
19. FM	Factory Mutual
20. HVAC	Heating, Ventilating, and Air Conditioning
21. MSS	Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
22. NEBB	National Environmental Balancing Bureau
23. NEC	National Electrical Code
24. NEMA	National Electrical Manufacturers Association
25. NFPA	National Fire Protection Association
26. NSF	National Sanitary Foundation
27. OAC	Ohio Administrative Code
28. OBC	Ohio Building Code
29. ODH	Ohio Department of Health
30. ODMH	Ohio Department of Mental Health
31. ODOE	Ohio Department of Energy
32. ODOT	Ohio Department of Transportation
33. OSHA	Occupational Safety and Health Administration
34. PDI	Plumbing and Drainage Institute
35. SMACNA	Sheet Metal and Air Conditioning Contractors National Association
36. TAB	Testing, Adjusting, and Balancing
37. UL	Underwriters' Laboratories

- B. The abbreviations are shown on Drawings. For further abbreviations, Contractor shall refer to the symbols list shown in the latest ASHRAE Fundamentals Handbook.

#### 1.06 DEFINITIONS

- A. Applicable definitions as listed by Ohio Building Codes apply to this work.
- B. "The Authority Having Jurisdiction" shall refer to any duly authorized governmental body or public utility and/or their agents having jurisdiction over the work as provided under this Contract.
- C. "Concealed": Embedded in or installed behind walls, within partitions, above suspended ceilings, in trenches, in tunnels, below floor slabs, and within crawl spaces. Items within mechanical rooms are not considered "concealed."
- D. "Contractor": Means the Contractor whose scope of work is described within Divisions 20, 21, 22, or 23.
- E. "Ductwork": Duct and fittings, dampers, vanes, controls, hangers, bracing, insulation and other items required or necessary.
- F. "Exposed": Not installed underground or "concealed," as defined previously. In full view, all items within a mechanical room are considered "exposed."
- G. "Furnish": To purchase and deliver products to the project site and make ready for installation.



- H. "Install": To take furnished products, assemble, erect, secure, connect, and place into operation.
- I. "Piping": Pipe, fitting, flanges, valves, controls, specialties, hangers, concrete inserts, bracing, insulation, and other items required or necessary.
- J. "Products": Includes materials, systems, and equipment.
- K. "Provide": To furnish, erect, install, and connect to make completely ready for regular operation.
- L. "Work": The providing of products for entire Contract.

#### 1.07 PERMITS, FEES, AND NOTICES

- A. Secure and pay for all permits and governmental fees, bonds, licenses, and inspections necessary for the proper execution and completion of the work. Refer also to specific permit requirements in other Sections of Divisions 20, 21, and 22 (as included) and in Division 1.
- B. Give notice and comply with all laws, ordinances, rules, regulations, and lawful orders of any public authority bearing on the performance of the work.
- C. The Plumbing, HVAC, and Fire Protection Contractors shall arrange for inspection of the work by the Code Authority having jurisdiction.
- D. If the Contractor performs any work knowing that work to be contrary to such Laws, Ordinances, Rules, and Regulations, and without notice to the Architect, the Contractor shall assume full responsibility for and shall bear all costs associated with such work.

#### 1.08 EXAMINATION OF SITE

- A. Certain existing conditions affect the manner or sequence of the work performance. Review existing services, structures, and operating schedules to facilitate installation of the Work. Coordinate scheduling of the work with existing operations.
- B. Visit the site of the proposed project and familiarize with all conditions which might affect the work. After the Contract is signed, no allowance will be made for lack of knowledge of project conditions.
- C. Prior to bidding the project, verify and reconcile work required by the Contract Documents with conditions at the Site.
- D. Should any discrepancies be noted during the Bidding Period, notify the Architect immediately, in writing, to permit the issuance of an addendum to prevent misunderstandings at a later date.

#### 1.09 UTILITIES

- A. Prior to construction, locate any existing utilities within the project limits. Make minor relocations to permit installation of work. Advise the Architect immediately of major conflicts on a site plan layout to permit modifications of the Contract Documents, and submit to the Architect for review prior to any excavation. Where existing utilities conflict with new work, mark and identify proposed modifications on the site plan layout.
- B. Record locations of all concealed utilities on the Record Drawings.
- C. Coordinate any utility service shutdown or outages with the Architect and the Owner. Shutdowns shall conform to all utility company requirements. Avoid inconveniencing the Owner, and provide temporary service during the curtailment, as required by the Architect or Owner. Provide five (5) working days (minimum) advanced notice to the Owner for any required utility outages.

#### 1.10 CONTRACTOR DESIGN/DETAILING

- A. The Contractor is required to include the design of component parts, subsystems, and installation details as required by the Specifications, as indicated on the Drawings, and as required for a complete and operating installation. This design work shall be done after all equipment manufacturers and material types have been selected from those allowed by the Specifications. If required by the Specifications, submit design calculations for review. Obtain the services of qualified personnel to perform this design and detailing. The Contractor's design and detailing does not relieve the Contractor from complying with the Contract Documents.

#### 1.11 RECORD DRAWINGS

- A. Maintain at the job site one (1) copy of Drawings, which shall be used exclusively for recording the location of all installed work.
- B. Record deviations in locations of concealed piping, valves, all buried or concealed utility services (water, gas, fire, manholes, etc.), dimensioned from a fixed control point, including depth of bury at start of gas line, at each change of direction as required for further reference. Minor piping variations need not be recorded. Record Addendum and Change Order Items.
- C. Record deviations necessary to incorporate equipment different from the Design Base equipment.
- D. At completion of the project, deliver Record Drawings and Coordination Drawings to the Architect.
- E. For large, complex electrical equipment, supply, and post at, on, or near the equipment, all electrical power and control drawings. Provide framed glass or plastic protection for the Drawings.

- F. Diagrams and Operating Instructions: Post complete diagrams and operating instructions for all control systems near the related equipment. Provide framed glass or plastic protection for the Drawings and operating instructions. When multiple equipment rooms exist in a building, these diagrams shall be required at each piece of equipment. Additionally, post or make available in the main equipment room a complete set of diagrams.
- G. Refer to Division 1, Section 01 74 01, "Execution Requirements," for additional requirements.

#### 1.12 GUARANTEE

- A. Guarantee equipment, workmanship, and materials for one (1) year from date of Contract Completion. If defects develop within this guarantee period, and upon receiving written notice from the Architect or Owner, remedy the defects and reimburse the Owner for all damage to other work caused either by the defects or during the work of correcting the defects.
- B. Refer also to Division 1 and any individual Sections that define the starting date of the guarantee period or discuss either additional warranty requirements or extended warranties beyond the standard period.

#### 1.13 COORDINATION

- A. Coordinate work carefully with the work of all other Contractors.
- B. Consult all contract documents that may affect the locations of any piping, and make minor adjustments in location to secure coordination.
- C. Before proceeding, coordinate drilling, welding, etc., and method of attachment to columns, joists, beams, girders, etc., with Structural Engineer and General Trades Contractor.

#### 1.14 TEMPORARY UTILITIES

- A. Refer to Division 1, General Requirements.
- B. Any and all equipment used for temporary building operation during construction shall be contingent on a plan submitted by the Contractor and approved by the Construction Manager and the Engineer. The criteria shall include, but not be limited to, the following:
  - 1. All necessary controls shall be in place and functional.
  - 2. All equipment safeties shall be functional.
  - 3. The equipment shall not be operated without the design filters in place and the filters shall be changed in accordance with the criteria on the Air Filter Schedule. Refer to Section 23 41 05 Filters for more information.
  - 4. Maintenance of the equipment shall be as recommended by the manufacturer and shall be the responsibility of the Contractor.
  - 5. The operation of the units for construction shall not affect the required warranty terms and times at the completion of the building.

## PART 2 PRODUCTS

### 2.01 DESIGN-BASE MANUFACTURERS

- A. The Drawings and Specifications are based on the requirements and layouts of the equipment of the Design-Base Manufacturers. Design of equipment has been coordinated with the building and other Trades for these specific models and manufacturers of equipment. Where several manufacturers are listed, the first named is the Design-Base Manufacturer, unless specifically noted otherwise. Submit for final approval products of the listed manufacturers that are of performance and quality comparable to the Design-Base Manufacturer's products.
- B. Where necessary, prepare new layouts to be used for other equipment listed. Adjust and coordinate the layouts with the equipment and service requirements and with Code-required working clearances that may have different dimensions or service requirements from the Design-Base Manufacturer's equipment. Verify that this equipment will fit and function in the indicated application and will coordinate with adjacent equipment for fit and clearances. Submit all new layouts as part of the shop drawing review.
- C. Whenever the Contractor furnishes equipment or material other than that of the Design-Base Manufacturer, he/she is responsible for the cost and coordination of all modifications required not only for his/her work, but also for the work of all other Trades affected. Where changes to other Trades' work are required, the Contractor furnishing the equipment or material must include the additional costs of all such changes in his/her Bid, arrange with these other Trades for the changes, and compensate them accordingly.

### 2.02 APPROVED EQUALS

- A. Equal (equivalent) components (articles, materials, forms of construction, equipment, fixtures, etc.) by manufacturers not listed but meeting the Specifications may be submitted to the Architect for approval and subsequent inclusion into the bidding documents. Submittal must be received no later than ten (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 Architect. Indicate the following:
    - a. Project name, project building 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: When required by Architect, submit appropriate samples of proposed product showing color, texture, construction, and other attributes necessary for evaluation.

- C. If the Contractor fails to comply with all of the preceding requirements and fails to provide all of the requested information, the submittal will not be reviewed.

## 2.03 SUBSTITUTIONS

- A. Contractor may submit equipment and material substitutions of his/her choice, without prior approval, on the "Substitution Sheet" included in the Bid Schedule. Such substitutions will not form the basis of the award and may be considered only after selection of the lowest bidder furnishing "Standards" as specified.

## 2.04 MANUFACTURER'S DECLARATION

- A. Submit a list of the suppliers to be used on this project within thirty (30) days of award of contract. Type this list on company letterhead and include the project title. Include all equipment listed in Section 20 05 15, "Submittals." Adjacent to each Specification Section number and product description, list the manufacturer and catalog number/type.

## 2.05 QUANTITIES

- A. Equipment may be referred to either in these Specifications or on the Drawings, as singular or plural; Contractor is responsible for verifying the exact number of items required to complete his/her work.

# PART 3 EXECUTION

## 3.01 CUTTING AND PATCHING

- A. Unless otherwise required in the General Conditions and other Specification Sections, the Contractor shall include in his/her Bid the cost of all cutting and patching required for his/her work. Work must be accomplished in a neat and workmanlike manner that is acceptable to the Architect.
- B. If necessary to cut into the work of other Trades, the other Trades shall do the cutting in at this Contractor's expense. Patching shall be done in the same fashion.
- C. Cutting of structural support beams, joists, plates, precast, or other structural members is strictly prohibited without the specific written consent of the Architect and Structural Engineer. Use rotary drills where cutting holes through concrete, brick, plaster, or tile is necessary. Obtain approval of the Architect before proceeding with work.
- D. 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.

- E. Patching shall match adjacent materials and shall be accomplished only by tradesmen skilled in the respective craft required. Materials and equipment used in the patching work shall comply with requirements of those Sections of the Specifications relating to material to be used in new construction. Contractor is not necessarily obliged to employ the General Trades Contractor to do patching. The HVAC, Plumbing, and Fire Protection Contractors shall incur all cost for cutting and patching necessary for their installation of their respective work.
- F. Patch to match adjacent surface construction. Exception: Portions of the existing floor slab shall be cut and removed by Contractor and replaced by the other Contractors is appropriate for the underfloor plumbing piping. Plumbing Contractor shall excavate and backfill for his/her own work.
- G. Patch and repair holes in walls, ceilings and floors that are left as a result of removing ductwork, piping, or other mechanical elements or as necessary to install the work related to this project. Match adjacent surface conditions. Coordinate patching with architect and work of other trades.
- H. Refer to Division 1 and Division 2 for additional requirements.

### 3.02 PAINTING AND RELATED WORK

- A. Finish painting in areas of new construction and remodeled areas is the responsibility of the General Trades Contractor and is specified in Division 9.
- B. Any other painting required by Sections of Division 20, 21, 22, or 23 is the responsibility of the respective HVAC, Plumbing, or Fire Protection Contractors. Such painting shall be done by a qualified tradesman skilled in the craft and shall meet the requirements of Division 9. Each Contractor is responsible for repainting of finished areas disturbed by his/her own cutting and patching. Finishes shall match existing conditions.
- C. If factory-finished equipment has rusted or has been damaged, clean the equipment, spot prime it with zinc chromate, and finish it to the original quality and color.
- D. Clean HVAC, Plumbing, and Fire Protection support steel and bare ferrous metal, remove all rust, apply primer, and paint in accordance with Division 9 Specifications.
- E. Prime and finish all plywood mounting boards in accordance with Division 9 Specifications.

### 3.03 CLEANING

- A. Upon completion of work, thoroughly clean of dirt, stickers, grease, rust, oil and other foreign matter, all material, fixtures, and equipment furnished in this Contract. Prepare for finish painting, where painting is specified.
- B. Clean galvanized piping and ductwork in exposed areas with diluted acetic acid.
- C. Clean copper piping in exposed areas with fine emery cloth and solvent.

- D. Clean all gauges, thermometers, traps, dirt legs, strainers, and fittings.
- E. Clean all insulation coverings.
- F. Keep all areas as clean as possible during construction. Refer to Division 1 for additional requirements.

#### 3.04 SCAFFOLDING, RIGGING, HOISTS, AND TRANSPORTATION

- A. The Contractor shall provide scaffolding, staging, cribbing, tackle, hoists, and rigging necessary for placing of his/her materials and equipment in their proper places in the Project.
- B. The Contractor shall pay costs for transportation of materials and equipment to the job site and shall include such costs in his/her proposal. The Contractor shall pay costs for storage of materials and equipment if space is not available at the site and shall include such costs in his/her proposal.
- C. Scaffolding and hoisting equipment shall comply with requirements of applicable Federal, State, and Local Laws and Codes.

#### 3.05 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 Architect must receive notification of all scheduled tests and adjustments at least 72 hours before they are scheduled so he/she may witness the tests and adjustments. If the Contractor performs any test or adjustment without the Architect present or without proper notification, the Contractor may be required to perform the test or adjustment a second time at the Contractor's expense. To minimize inconvenience, all test schedules shall be coordinated with the Owner.
- C. Secure required certifications of inspection, testing, or approval and include those in the Service Manuals. See Section 20 05 20, "Record and Information Manuals."
- D. Test and secure approval after the piping installation has been completed, but before the piping has been concealed and before the pipe covering has been applied. Each system shall be tested as required by other Sections of this Specification. The piping shall be free of leaks at the test pressure. If a leak appears, repair the line and any damage resulting from the leak at no additional cost to the Owner. The test shall be repeated until the system is proven to be free of leaks and properly anchored.
- E. Should any of the work be covered up or enclosed before all required inspections are completed and approvals obtained, uncover the work as required and, after the work has been completely inspected and approved, make all repairs and replacements, with such materials and workmanship as are necessary for the approval of the Architect. Do so at no additional cost to the Owner.

### 3.06 TESTING PROCEDURES

- A. Provide all tools, instruments, personnel, and equipment required to perform tests. Make all required temporary connections. Properly repair defects that develop under tests and repeat the tests. Do not caulk threaded joints, cracks, or holes. Repair leaks by tightening threaded joints or by replacing pipe, fittings, or equipment with new materials. Minor leaks in welded joints may be chipped out and rewelded.
- B. Perform hydrostatic and air tests before piping is concealed or covered. Completely drain all systems after hydrostatic tests are performed.
- C. Testing of service lines shall follow recommended practices. Remove all air from lines when testing with water pressure, to avoid false pressure readings.

### 3.07 INSPECTION

- A. Check each piece of equipment in the system for defects. Verify that all parts are properly furnished and installed, that all items function properly, and that all adjustments have been made.

### 3.08 PROTECTION

- A. Do not deliver equipment and material to the site until the work is ready to receive it, unless it can be protectively stored in a manner acceptable to the Architect.
- B. During construction, protect all equipment and materials during construction from damage by weather, water, dirt, paint droppings, welding and cutting spatters, and other construction activities.
- C. Elevate and protectively cover all materials or equipment stored outside.
- D. Store inside all materials and equipment sensitive to weather or construction conditions. Where necessary, store sensitive equipment in a heated area.
- E. During construction, cover all non-operating motors, bearings, and controls that are stored or installed in place.
- F. Refer also to individual Specification Sections for specialized protection.
- G. Immediately repair or replace damaged equipment or materials to the satisfaction of the Architect and at no additional cost to the Owner.
- H. Protect the building and other Contractor's material and equipment from damage caused by your work. Protect floors from cutting oil and chips.
- I. Use all means necessary to protect materials before, during, and after installation.



3.09 NOTIFICATION OF START-UP

- A. Notify the Architect of the start-up schedule for all equipment. The Architect shall then notify the Owner.

3.10 PROTECTION FOR PUBLIC AND EMPLOYEES

- A. Refer to Division 1, General Requirements.

3.11 TEMPORARY FIELD OFFICE AND MATERIALS STORAGE

- A. Refer to Division 1, General Requirements.

3.12 USE OF EXISTING FACILITIES

- A. Refer to Division 1, General Requirements.

3.13 DEMOLITION AND REMOVAL

- A. Refer to Division 1, General Requirements.

END OF SECTION

SECTION 20 05 10 - COORDINATION BETWEEN TRADES

PART 1 GENERAL

1.01 DESCRIPTION

- A. Plumbing, Fire Protection, HVAC, and Electrical Contractors shall coordinate their rough-in, service, and control wiring requirements with each other. Electrical Contractor shall review all control Drawings to coordinate exact number of temperature control panels, as well as to provide proper starters (including necessary time delays, auxiliary contacts, etc.).
- B. Equipment drawing 1,000 watts or more, before power factor correction, must have a power factor of 85% or greater at rated load conditions. Equipment with an operating power factor of less than 85% shall be corrected to at least 90% under rated load-operating conditions. The Contractor furnishing the equipment shall be responsible for power factor correction devices.
- C. The Electrical Contractor shall install all wiring required to power Plumbing, Fire Protection, or HVAC equipment, including 120 volt to control panels as shown. The Contractor furnishing the control device is responsible for all control and interlock wiring, regardless of voltage, except if the control device actuates or is actuated by the fire alarm control panel. The Electrical Contractor shall be responsible for this wiring from the fire alarm control panel to the control device. The Contractor providing a control panel shall extend control power for temperature control panels required, but not shown on the Drawings from the nearest available breaker to the control panel.
- D. Each Contractor furnishing motors is responsible for advising Electrical Contractor of the exact function of the systems to assure proper type of starter (including necessary time delays, etc.) with correct number of auxiliary contacts required for proper system operation. If motors that require larger starters, safety switches, circuit breakers, fuses, or branch circuit conductors than indicated are furnished, the Contractor furnishing the motors shall reimburse the Electrical Contractor for any cost differential.
- E. All electrical devices furnished as part of Plumbing, Fire Protection, and HVAC equipment, and the installation requirements for all electrical work included in the project, shall conform to all other applicable Sections of these Specifications.
- F. The Plumbing, Fire Protection, and HVAC Contractors shall be responsible for start-up, commissioning, and final operation of equipment provided under their respective contracts and shall demonstrate the operation of all systems to the Owner. Provide the appropriate personnel for the checkout of the building life safety systems and for the life safety system demonstration to the Authorities having jurisdiction.

1.02 COORDINATION

- A. The Plumbing, Fire Protection, HVAC, and Electrical items are listed in the Coordination Schedule, with key letters and numbers to identify the responsibility of each Contractor. The following two (2) paragraphs describe the key numbers and letters.
- B. Combinations of Contractors doing the different parts of the work are identified as follows:
  - 1. To be furnished and installed by Plumbing, Fire Protection, or HVAC Contractor supplying the equipment.
  - 2. To be furnished and installed by Electrical Contractor.
  - 3. To be furnished by Plumbing, Fire Protection, or HVAC Contractor and installed by Electrical Contractor.
  - 4. To be furnished by Owner and installed by Plumbing, Fire Protection, or HVAC Contractor.
  - 5. To be furnished by Owner and installed by Electrical Contractor.
- C. The items to be furnished are identified by key letters as follows:
  - A - Disconnect
  - B - Line voltage starter
  - C - Reduced voltage starter
  - D - Combination disconnect starter
  - E - Factory pre-wired control panel with integral starter
  - F - Variable Frequency controller
  - G - Duplex outlet

1.03 COORDINATION SCHEDULE

ITEMS	A	B	C	D	E	F	G
HVAC:							
Air-handling unit	2	2					
Unit heater (water)	2	2					
Exhaust fan	2	2					
Air-cooled condensing unit	1				1		
Air cooled chiller	2				1		
Rooftop unit	2				1		
Unit heater (electric)	2				1		
VAV air-handling unit	1						3

1.04 BUILDING AUTOMATION AND TEMPERATURE CONTROL

- A. Coordinate all Building Automation System and Temperature Control System components and installation as noted in Specification Sections governing that work.

END OF SECTION

## SECTION 20 05 13 - MOTORS

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. All motors provided as part of equipment or appliances that are driving pumps or fans shall meet the requirements stated within this specification.
- B. Motors 1/2 horsepower or smaller shall be single phase; larger motors shall be 3 phase, unless otherwise noted.

#### 1.02 QUALITY ASSURANCE

- A. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM.
- B. Motors must meet or exceed CEE Premium Efficiency™ full load efficiencies.
- C. The motors shall be provided with a three (3) year full parts and labor warranty, commencing at Project Completion. Warranty periods that begin at startup or on a ship date are not sufficient.

#### 1.03 MANUFACTURERS

- A. Baldor Electric, Reliance, Lincoln, General Electric, US Motors, Marathon.

#### 1.04 RELATED WORK SPECIFIED ELSEWHERE

- A. Conformance with all sections of the Specifications is required.

### PART 2 PRODUCTS

#### 2.01 GENERAL CONSTRUCTION

- A. Motors shall be ODP (Open Drip-proof) or TEFC (Totally Enclosed Fan-Cooled), or TEAO (Totally Enclosed Air Over) as noted in individual product specifications, NEMA T frame, NEMA F1 assembly for horizontal applications. Enclosures shall be rolled steel band or cast iron construction depending on horsepower. End brackets shall be die cast aluminum with steel bearing inserts or cast iron construction. Conduit box shall be die cast aluminum or cast iron construction. Provide shouldered lifting eyebolts or cast provisions within the frame for handling convenience.
- B. The manufacturer shall be notified that the motor will be used in conjunction with a variable frequency drive. It shall be the responsibility of the motor manufacturer to ensure that this motor will be capable of operating under the torque requirements and speed range within temperature specifications. Motors shall be designed to be used with variable frequency drives (VFD) and shall be inverter-ready.

- C. Motor nameplate shall be mounted on enclosure with stainless steel fastening pins. Nameplate shall have, as a minimum, all information as described in NEMA Standard MG-1-20.60.
- D. Motor terminal boxes shall be sized larger than required by NEC or UL standards, pipe drilled for conduit and shall be attached to the motor frame with cadmium-plated hex head cap screws. Cover shall be installed with cadmium plated hex head cap screws. The conduit box shall come completely assembled to the motor. Motor leads in the conduit box shall be sized in accordance with NEC suggested minimum ampacity values using a minimum of 125 degrees C insulated lead wire.

2.02 RATINGS AND DESIGN

- A. Motors shall be premium efficiency, NEMA Design A, squirrel cage, induction type. Motors shall be rated in accordance with NEMA Rev. 1, Part 31.40.4.2 with 1600 volt insulation and meet the tabulated efficiencies at full-rated RPM.
- B. Minimum efficiencies for ODP motors shall be equal to or greater than those shown below:

<u>HP</u>	<u>1200 RPM</u>	<u>1800 PM</u>	<u>3600 RPM</u>
2	87.5	86.5	86.5
3	89.5	89.5	86.5
5	89.5	89.5	89.5
7.5	91.7	91.0	89.5
10	91.7	91.7	90.2
15	92.4	93.0	91.0
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	94.1	93.0
40	94.1	94.1	93.6
50	94.1	94.5	93.6
60	95.0	95.0	94.1
75	95.0	95.0	94.5
100	95.0	95.4	94.5
125	95.4	95.4	95.0
150	95.8	95.8	95.4
200	95.4	95.8	95.4

- C. Motors shall be wound for 460 or 208 volt (as required), 3 phase, 60 Hz, 1.15 service factor.
- D. Windings shall be copper magnet wire rated at 200 degrees C and moisture resistant. Motor insulation system shall comply with NEMA MG1-1998 Part 31.4.4.2.
- E. Motors shall be furnished with standard NEMA T-frame shaft for V-belt drives even if motors are for direct connected drive duty. In general, motor shall be interchangeable for horizontal, vertical or belt-driven mounting.
- F. Rotors shall be keyed and shrunk or pressed to the shaft. Keyed rotors shall be press-fitted on a shoulder the full length of the rotor utilizing the full shaft surface diameter.

- G. Provide AEGIS shaft grounding rings on all motors operated by variable frequency drives to divert shaft voltages and bearing currents to ground. Motors up to 100 horsepower in size shall have one ring installed on either the drive end or the non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. All grounding rings shall be installed in accordance with manufacturer's installation instructions.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Properly tension and align drive belts.
- B. After units have been operating for 48 hours, check all bearings, belts and sheaves. Tighten sheaves and tension belts as necessary.
- C. Operate system for a minimum period of 7 consecutive days with no problems before final acceptance.
- D. In retrofit or replacement applications, confirm existing motor mounting configuration and critical dimensions prior to ordering replacement motors. Provide replacement sheaves and belts, as required, to account for any dimensional differences between the existing motors and the replacements.

END OF SECTION

SECTION 20 05 15 - SUBMITTALS

PART 1 GENERAL

1.01 DESCRIPTION

- A. For general requirements, refer to the GENERAL CONDITIONS and Division 1.
- B. Materials and equipment installed in this work shall meet all the requirements of the Contract Documents and no materials or equipment shall be ordered until submittals are reviewed and approved by the Contractor, Architect, and Engineer.
- C. Contractors assume all responsibility for changes required as a result of work performed, or equipment ordered, by the Contractor prior to submittal approval.
- D. Submit complete copies of the catalog data or Drawings for each manufactured item of equipment and each component to be used in the work as required in the table below. Catalog data shall include specific performance data, utility requirements, service area required, material description, rating, capacity, working pressure, dimensional data, material gauge or thickness, wiring diagrams, brand name, catalog number, and general type.
- E. Submittals reviewed by the Engineer shall not take precedence over the Contract Documents, and the Engineer's review shall not relieve the Contractor from the responsibility for complying with the Drawings or Specifications, nor from the responsibility for providing proper clearance and coordination with other Trades.
- F. When submitted for review, all shop Drawings shall bear the Contractor's certification that he/she has reviewed, checked, and approved the shop drawings, that they have been coordinated with the requirements of the project and the provisions of the Contract Documents, and 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 and will be returned.
- G. 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 may be submitted earlier.
- H. The Engineer's review and approval does not extend to means, methods, manners, techniques, sequences, procedure of construction or to safety precautions or programs incident thereto. This is solely the Contractor's responsibility.
- I. Shop Drawings that are submitted, but are not required by the table below, will not be reviewed, and they will not be returned.
- J. Shop Drawings that are indicated to be provided for Record Purposes only will not be reviewed, and they will not be returned.

## 1.02 CONTRACTOR'S RESPONSIBILITIES

- A. Completely review and approve shop Drawings, product data, and samples prior to submittal.
- B. Determine and verify:
  - 1. Field measurements
  - 2. Field construction criteria
  - 3. Catalog numbers and similar data
  - 4. Conformance with Specifications
  - 5. Quantities
- C. Coordinate each submittal with requirements of the work and the Contract Documents and other Trades.
- D. Notify the Architect 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.
- E. 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.
- F. 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.
- G. Do not begin fabrication or work that requires submittals until approved submittals are returned.

## 1.03 CERTIFICATIONS

- A. Provide:
  - 1. Test Agency results verifying capacities, operating conditions and power requirements at design conditions. Test Agencies are to be hired by the Contractor at the Contractor's expense.
  - 2. Manufacturer's Statement of Compliance with Standards discussed in individual Specification Sections.
  - 3. Equipment labels indicating Certification requirements.
  - 4. Quality standard designations on each unit piece, for example, each pipe length, pressure vessel, or valve.
  - 5. Typed verification that noted mixes, chemical compositions, and testing procedures were complied with.
  - 6. Other Certifications listed in other Sections of the Specifications.



1.04 REQUIRED SUBMITTAL INFORMATION (ALSO REFER TO DIVISION 1)

- A. Submittal Transmittal
  - 1. Provide the following information on the Transmittal Form for each submittal:
    - a. Project name
    - b. Specification number for each submittal item required in table below
    - c. Item description, as listed for each submittal item required in table below. Where equipment is identified by number or tag on the documents, use the same identification on the submittal.
    - d. Specification number and item description (b and c, preceding) for each submittal if more than one (1) submittal is sent under one (1) transmittal form.
    - e. Name, address, and telephone number of Contractor.
    - f. Bid package number.
  - 2. Submittal transmittal forms not properly identified with the preceding information will be returned (without review) to the Contractor.
  
- B. Shop Drawing Requirements
  - 1. Shop Drawings – Provide catalog cuts, Drawings, warranties, motor efficiencies and power factor information (where applicable), wiring diagrams (where applicable), performance curves and characteristics. Shop drawings shall be submitted electronically in PDF file format and as described in Division 1. The submittals will be returned to the Contractor, who will make and distribute as many copies as needed. Only submittals with the approved stamp printed on them shall be permitted on the site.
  
- C. Submit ductwork layout shop Drawings for record purposes only after coordination between all Contractors has occurred. Drawings shall be at 1/4 inch equals 1 foot scale and shall include duct, top and bottom elevations with enlarged sections and elevation plans as necessary. Coordinate size and location of ductwork with structure, piping, lighting, equipment, conduit, bus ducts, ceiling construction, clear height above, and other items that may present a potential conflict. These Drawings will not be reviewed or returned.
  
- D. Submit HVAC piping layout shop Drawings for record purposes only after coordination between all Contractors has occurred. Drawings to be a 1/4 inch equals 1 foot scale with enlarged sections and elevation plans as necessary. Identify all valve locations, as well as all piping and support elevations. Coordinate size and location of ductwork with structure, ductwork, lighting, equipment, conduit, bus ducts, ceiling construction, and Owner's desired clear headroom. These Drawings will not be reviewed or returned.
  
- E. Certain Fire Protection Shop Drawings listed in the table below are to be provided to the Engineer for record purposes only. The final approval for these systems is by the Authority Having Jurisdiction (AHJ). Provide these submittals to the AHJ for their approval prior to installing work. The Engineer will not review or return these Drawings.

- F. Each Contractor shall submit information on the equipment items as listed in the following table. Identify each item with Specification numbers.

Section #	Item	Provide for Approval	Provide for Record Purposes Only
<b>General Items for Plumbing, Fire Protection, and HVAC</b>			
20 05 05	Suppliers and manufacturers list	X	
20 05 20	Record and information manuals	X	
20 05 35	Fire stops through floors and walls		X
20 05 40	Piping expansion, noise and vibration isolation	X	
20 05 45	Hangers, supports, and inserts (Non-Seismic)	X	
20 05 61	Power factor correction		X
20 05 80	Vibration Isolators	X	
<b>Fire Protection Contract Items</b>			
20 05 99	Certificate for approval from state fire marshal		X
21 05 02	Fire protection specialties	X	
21 05 23	Fire protection valves		X
21 13 13	Wet sprinkler piping system		X
21 13 14	Limited area sprinkler piping system		X
<b>HVAC Contract Items</b>			
23 05 02	HVAC specialties	X	
23 05 23	HVAC valves	X	
23 05 93	HVAC systems balancing	X	
23 07 05	HVAC Insulation	X	
23 09 23	Temperature control systems	X	
23 09 93	Sequences of Operation	X	
23 21 13	Pressed and grooved fittings	X	
23 21 16	Pressed fittings	X	
23 31 10	Low-velocity ductwork - Fabrication Drawings		X
23 31 11	High-velocity ductwork - Fabrication Drawings		X
23 31 12	Acoustically insulated ductwork – Fabrication Drawings		X
23 33 13	Dampers	X	
23 34 17	Fans	X	
23 38 16	Laboratory canopy hoods	X	
23 41 05	Filters	X	
23 73 23	Custom air-handling units	X	
23 81 28	Variable refrigerant flow air conditioners	X	
23 82 16	Hot water coils	X	
22 82 36	Finned tube and panel radiation	X	
23 82 39	Unit heaters	X	
23 90 71	Variable Frequency Drives (VFD)	X	

END OF SECTION

SECTION 20 05 20 - RECORD AND INFORMATION MANUALS

PART 1 GENERAL

1.01 RECORD DRAWINGS

- A. Refer to Division 1 for general requirements as well as for specific information regarding Record (As-Built) Drawings. All drawings shall be provided in electronic PDF format.

1.02 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 1 for general requirements and for specific information regarding Operation and Maintenance Manuals, including required format(s) (paper and/or electronic) and quantity. If no such requirements are listed in Division 1, provide in electronic format. Submit one (1) copy of draft manual to the Architect for review and approval thirty (30) days before final inspection is due. After approval, submit three (3) approved manuals to the Owner and obtain receipt. (See Section 20 05 99, "Requirements for Contract Completion.")
- B. Paper Copy Manuals shall be loose leaf, three-ring, heavy-duty hard-cover binders. Material shall be typewritten or printed and be fully legible. Each section shall be divided by labeled tabs.
- C. Electronic Copy Manuals shall be PDF file format. Individual documents shall have filenames corresponding to specification sections and system names. Each document shall have bookmarks corresponding to the systems, subsystems, and equipment names. Use electronic files prepared by manufacturers where available.
- D. The following items, together with any other necessary pertinent data, shall be included in each Manual:
  - 1. Each manual to be labeled on front cover with Project name, Contract, Contractor's name, Architect's name, Engineer's name, and date of Project Completion.
  - 2. Manufacturers' names, nearest factory representative (including postal and e-mail address, telephone and fax number), and model and serial numbers of components of systems.
  - 3. Name, postal and e-mail address, telephone and fax number of contact persons handling warranty work and issues.
  - 4. Operating instructions, including start-up and shut-down procedures.
  - 5. Maintenance and lubrication instructions, including routine and emergency service information and instructions.
  - 6. Parts list with numbers of replaceable items (such as couplings and packings). Include sources of supply, with postal and e-mail address, telephone and fax number.
  - 7. One (1) approved copy of each shop Drawing submitted.
  - 8. Temperature control diagrams.
  - 9. Valve charts.
  - 10. Written warranties.
  - 11. Belt sizes, types, and lengths.
  - 12. Wiring diagrams, as actually wired.
  - 13. Testing and balancing reports.

14. Copy of Owner's statement concerning completion of instruction period (see Section 20 05 99, "Requirements for Contract Completion").
15. Routine and 24-hour emergency service and repair information:
  - a. Name, post and e-mail address and telephone and fax number of servicing agencies - routine and emergency.
  - b. Names of personnel to be contacted for service arrangements - routine and emergency.

### 1.03 CONTROL DIAGRAM AND VALVE CHART

- A. In the main Mechanical Room or location designated by Owner's Representative, mount approved copy in a neat frame with backing under glass or within a plastic jacket.

END OF SECTION

SECTION 20 05 30 - CONCRETE BASES AND SUPPORTS

PART 1 GENERAL

1.01 CONCRETE WORK

- A. Provide all concrete bases required for equipment supplied under this Division. Coordinate all pertinent dimensions, details, and cast-in-place items with the equipment being supplied.
- B. All other concrete work incidental to the work of this Division is the responsibility of this Division's Contractor. Conform to the quality standards in Division 3. Such concrete includes but is not limited to:
  - 1. Backfill in trenches, where required to be concrete
  - 2. Pipe or duct encasement, thrust blocks, and similar concealed work
  - 3. Manholes, interceptors, catch basins, or other underground structures
- C. Do not mount equipment on concrete supports until concrete has had sufficient setting time (seven (7) days minimum).

1.02 SUPPORT STEEL

- A. In general, all hangers, concrete anchor bolts, brackets, and other steel supports incidental to the work of this Division are to be provided by this Division's Contractor. Conform to the quality standards in Division 5. Only major support framing shown on the structural Drawings is to be provided by the others. For the proper execution of this work, provide all pertinent dimensions, details, and weights to those others.

PART 2 PRODUCTS

2.01 PREFABRICATED ROOF CURBS

- A. Construction: Minimum 18 gauge galvanized steel, continuous welded seams, mitered corners, pressure treated wood nailer strip, 12 inches minimum height above finished roof elevation, and counterflashing with lag screws. Where curb is used for equipment support, provide integral base plates and internal reinforcing as required to support equipment load. Where curb is around a roof penetration, provide 1 1/2 inch thick, 3 lb. density rigid fiberglass insulation. Provide pitched roof curb as required to keep equipment level.
- B. Manufacturers: Pate Company, Louvers & Dampers, Inc., Vent Products Company, Swarthwout, Inc., Shipman Industries, or Thy-Curb.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Other Contractors, as appropriate, shall provide roof openings and installation of roof curbs.
- B. The HVAC Contractor shall coordinate the size and location of all roof curbs, to avoid trapping water from ponding.
- C. Provide weathertight curb caps if equipment cannot be set immediately.
- D. Install thrust blocks at least 72 hours before testing the water lines.

END OF SECTION

SECTION 20 05 35 - SLEEVES, SEALS AND FIRESTOPS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish sleeves for pipe and duct penetrations through precast concrete, masonry, and concrete construction or where piping or ductwork passes through walls, through smoke-rated or fire-rated separations, and equipment room walls and floors.
- B. Provide watertight, corrosive service, oil-resistant service, and fire rated seals and firestops as specified herein.
- C. Use sleeving with absolutely watertight seal for piping passing through all foundation walls, floor slabs on grade, and other below grade penetrations into building.
- D. Provide dimensions and locations of openings for sleeves, piping, ducts, louvers, grilles, and similar items to the Contractor requiring the information.
- E. Carefully coordinate and check locations of sleeves immediately before and after each concrete pour and masonry installation.
- F. Provide approved firestop materials around all penetrations through fire-rated construction walls and floors per ASTM E814 and ASTM E119, including but not limited to pipes, ducts, drains, closet flanges, conduits, and raceways.
- G. At no additional cost to the Owner, correct unacceptable seals and firestops, and provide additional inspection as necessary to verify compliance with this Specification.

1.02 QUALITY ASSURANCE

- A. Firestop materials shall be classified by UL as "fill, void, or cavity materials" and "through penetration firestop systems."
- B. Firestop materials shall conform to both Flame (F) and Temperature (T) ratings as tested by nationally accepted test agencies per ASTM E814 or UL 1479 Fire Tests of Through-Penetration Firestops.
  - 1. The F rating shall be a minimum of one (1) hour but not less than the fire-resistance rating of the assembly being penetrated.
  - 2. Conduct the fire test with a minimum positive pressure differential of 0.01 inches of water column.
- C. Firestop materials and equipment used shall be in accordance with the manufacturer's written installation instructions. Installer shall be experienced, certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. Note that a manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

- D. Firestop materials shall be expanded to fill cavities or provide adhesion to substrates that will maintain seal under normal expected movements of substrates.
- E. For those firestop applications that exist for which no UL-tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment Drawings must follow requirements set forth by the International Firestop Council.

#### 1.03 SUBMITTALS

- A. Submit the following in accordance with Section 20 05 15, "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 firestop systems meet firestop requirements specified herein.
- B. To be included in Record and Information Manuals:
  - 1. One (1) copy of each approved submittal.

#### 1.04 MANUFACTURERS

- A. Seals:
  - 1. "Link-Seal" by Thunderline Corporation
  - 2. CSD Sealing Systems
  - 3. Calpico
  - 4. Wayne
  - 5. Michigan
  - 6. Metraflex
- B. Firestop materials:
  - 1. Hilti
  - 2. 3M
  - 3. CSD Sealing Systems
  - 4. Johns-Manville
  - 5. Tremco
  - 6. Rectorseal
  - 7. Proset Systems
  - 8. Nelson
  - 9. Firestop "Flame Safe"
  - 10. STI

### PART 2 PRODUCTS

#### 2.01 SLEEVE MATERIAL

- A. For sleeves less than 8 inches in diameter, use machine cut, standard weight, black steel pipe. Fabricate sleeves 8 inches in diameter and larger from 12 gauge galvanized steel sheet.



- B. Use copper sleeves for bare copper piping.
- C. Sleeves to be large enough for insulation to be continuous or for seals to be installed, but clearance all around to be less than 1/4 inch for both insulated and uninsulated pipes that penetrate walls and slabs.
- D. Proset system prefabricated fire-rated sleeves may be installed as an option for poured-in-place concrete or through cored holes in floors or masonry walls.
- E. Provide with waterstop anchor flange at midpoint where penetrating below grade floor slab or exterior structure at or below grade. Sleeves shall have a full-length welded intermediate flange and be imbedded in masonry. The Contractor may provide steel wall sleeves by Link-Seal or Proset Systems Prefabricated Sleeve System.

## 2.02 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 (2) identical piece plugs made of synthetic rubber with one edge flanged, serrated profile on the outside, and on the inside a series of ridges that compress and assure 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.

## 2.03 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. OPTION: Proset System Elastomeric Seals.

## 2.04 FIRE-RATED SEALS

- A. Sealing-plug-type fire-rated seals shall be made of fire resistance rated rubber for three (3) hour fire resistance rating. OPTION: Proset System Elastomeric Seals.

## 2.05 OIL RESISTANT SERVICE SEALS

- A. Modular, mechanical-type, oil-resistant-service seals shall have zinc galvanized 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. OPTION: Proset System Elastomeric Seals.

## 2.06 CORROSIVE-SERVICE SEALS

- A. Modular, mechanical-type corrosive-service seals have stainless steel bolts and nuts with rubber sealing element that is highly resistant 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.

## 2.07 FIRESTOPPING MATERIALS

- A. Penetration sealants:
  - 1. 3M Brand "Fire Barrier" caulk, putty or penetrating sealing systems
  - 2. CSD Sealing Systems CSD-FW and CSD-F caulk and putty
  - 3. Johns-Manville "Cerafiber"
  - 4. Rectorseal "Metacaulk"
  - 5. Tremco
  - 6. Hilti
  - 7. Firestop "Flame Safe"
  - 8. Spec Seal
- B. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire resistance-rated systems. Contractor shall be responsible for using the correct method and type of fire sealant and fire-rated seals in each type of installation.
- C. All firestop installations shall be UL rated.

## PART 3 EXECUTION

### 3.01 CUTTING

- A. Cut sleeves through walls flush with each surface. Unused sleeves shall extend beyond wall surface and be capped on each end.
- B. Cut sleeves 3/4 inch above finished floors or concrete curbs and 4 inches above floors in equipment rooms, rooms with floor drains, and shafts. Sleeves through waterproof floors shall project a minimum of 4 inches above the floor. Cut bottom of sleeve flush with bottom of floor.
- C. Core drill holes for sleeves in existing construction.
- D. Patching shall be by others at this Contractor's expense.

### 3.02 INSTALLATION OF SLEEVES

- A. Carefully coordinate and check locations of sleeves immediately before and after each concrete pour and masonry installation. Install cast-in-place sleeves subject to the following limitations:
  - 1. Do not embed aluminum without prior approval of coating material.
  - 2. Do not displace reinforcing steel.
  - 3. Maintain a center-to-center spacing of at least 3 diameters of sleeve.
  - 4. Do not install sleeves in any concrete beam, unless specifically shown on the structural Drawings.
- B. Give other Contractors as appropriate locations and sizes of all openings required for sleeve installation before construction of masonry or concrete walls and floors is started. If it is necessary to cut into the new work of other Trades due to the failure of this Contractor to provide proper notification, the other Trades shall do the cutting in at this Contractor's expense. Patching shall be done in the same fashion.
- C. Core drill hole for sleeves in existing construction after locations have been approved by the Structural Engineer and General Contractor.
- D. Size sleeves with 1/4 inch minimum and 1 inch maximum clearance all around pipe or pipe insulation.
- E. Piping is not to bear on sleeves. Install sleeves plumb with respect to wall.
- F. Minimize gaps between sleeve and ducts and pipes passing through walls and floors. Seal space up to a 1/2 inch gap with sealant or caulking. Close off space greater than 1/2 inch gap with sheet metal and seal airtight. To maintain fire rating of structure, pack all fire-rated separation sleeves with fire retardant or other noncombustible material. To fill space around all sleeves leading into exposed areas, use material compatible with adjacent construction and finish.
- G. Plug, pack, and finish unused sleeves to match adjacent surface and be compatible with their ratings.
- H. Use sleeves where round or oval duct openings are required through exposed walls, smoke or fire partitions, or equipment room walls. Close off all spaces around rectangular ducts through these walls.
- I. Provide chrome plated wall or floor escutcheons, sized to cover opening and seal, for all exposed installations.

### 3.03 INSTALLATION OF SEALS AND FIRESTOPS

- A. Clean surfaces and substrates of dirt, oil, loose materials, and other foreign materials that may affect the proper bond or installation of seals and firestopping.

- B. Do not apply seals and firestopping 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, that conform to manufacturer's recommendations for various substrates and conditions.
- C. Follow manufacturer's written instructions for installation of seals and firestopping.
- D. To ensure an effective smoke seal and to maintain the assembly's fire-resistance rating, install firestops with sufficient pressure to fill seal holes, voids, and openings.
- E. Tool or trowel exposed surfaces. Remove excess firestop material promptly as work progresses and upon completion.
- F. Fill and surround unused sleeves with firestop material. Sleeve ends. Contractor may use blind sealing plugs.
- G. Install watertight seals for all below grade penetrations of piping into the building.
- H. To maintain the fire-rating of the structure, pack all openings in fire-rated walls and floors and between sleeves and pipes with noncombustible material. Pipe insulation shall not be continued through a rated partition, unless sealant assembly is listed for use with continuous insulation. Maintain vapor barriers at all penetrations.
- I. Install oil-resistant-service seals in environment where oils, fuels, solvents, and other petroleum-base products are used.
- J. Install corrosive-service seals in environments where organic materials, acids, alkalis, and related chemicals are used.

### 3.04 INSPECTION

- 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. At no additional cost to the Owner, correct unacceptable seals and firestops, and provide additional inspection to verify compliance with this Specification.
- C. Maintain a current, legible copy of the manufacturer's written instructions for installation of seals and firestopping at the project site, for all products being used on the Project. Make installation instructions available on request for all Inspecting Authorities, the Architect, and the Engineer.

END OF SECTION

SECTION 20 05 40 - PIPING EXPANSION, NOISE AND VIBRATION ISOLATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Provide thermal expansion control for all piping.
- B. Isolate all piping for both noise and vibration transmission.
- C. To prevent damage to building, equipment, joists, hangers, and piping, provide expansion loops, expansion joints, guides, anchors, and offsets in piping systems as necessary to accurately control pipe movement resulting from equipment operation or thermal gradients.
- D. Provide pump connectors for each pump 1 hp and larger.
- E. Provide flexible connectors on all piping to equipment 5 hp and larger and where shown on equipment of lower horsepower.
- F. Provide expansion joints and accompanying anchors and guides where shown, or where expansion cannot be provided for with loops and offsets.

1.02 MANUFACTURERS

- A. Metraflex Company, Flexible Metal Hose, Wheatley, Proco, Mason Industries, or General Rubber.

PART 2 PRODUCTS

2.01 PUMP CONNECTORS (HYDRONIC SYSTEMS)

- A. 1 1/2 Inch and Smaller: Metraflex SST, 250 degrees F, 400 psig, Type 321 stainless steel corrugated inner tubing and outer wire braid shield, threaded ends.
- B. 2 Inches and Larger: Metraflex "Metraflex Style R" or "Cablesphere", 150 psig rating at concurrent 200 degrees F, EDPM and nylon molded globe, bias-ply tire cord reinforcing, cadmium-plated 150 ASA steel companion flanges. Provide restraining cables or rods to limit axial growth.

2.02 EXPANSION JOINTS

- A. Stainless steel bellows and elements, cast iron equalizing rings, tie-rods and pipe connections as required, 300 psig working pressure. Use packless, internally guided type for lines 2 inches and smaller. Provide internal liner for steam systems. Metraflex Model MC.

### 2.03 FLEXIBLE CONNECTORS

- A. Flexible rubber connector, 22 degrees F, 150 psig, 150 lb. ASA flanges, steel retaining ring.

### 2.04 PIPE ALIGNMENT GUIDES

- A. All heating hot water and low-pressure steam lines shall be guided by a painted steel cylinder guide assembly with welded mounting brackets and two piece pipe clamp "Spider" assembly.
- B. All high-pressure steam lines shall be supported on painted steel "T-pipe" guided slides, welded to pipe and base plate welded to support steel. Pipe slide and slide plate both to have factory bonded PTFE coating. Size units to conform with manufacturer's ratings for elevated temperatures. Typical support shall allow movement in axial direction only (PHD Fig. 690, Type 3 or approved equal). Within 12 feet of bends (or as indicated on the Drawings), support shall be allowed for horizontal movement in any direction (PHD Fig. 690, Type 6 or equivalent).
- C. Provide galvanized steel U bolts (PHD Fig. 91 or equivalent) nutted firmly in place for alignment, with insulation guard and shield on heating hot water, low-pressure steam, condensate, condensate pump discharge, and chilled-water systems, installed on stands or racks.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Line Expansion:
  - 1. U Bends: In all piping subject to expansion and contraction, install U Bends or loops in piping, in accordance with ASHRAE Equipment Handbook.
  - 2. Expansion Joints: Where space is insufficient to provide U Bends, or where specifically shown or specified, provide expansion joints. Install according to the manufacturer's instructions.
- B. Branch Connections:
  - 1. Make branch connections to mains with a minimum of two (2) 90 degree elbows, and incorporate at least one (1) change of direction in the horizontal plane and one (1) change of direction in the vertical plane before connecting to equipment or fixtures, or dropping into or rising in a wall.
  - 2. Bullhead connections in any piping services are expressly prohibited.
- C. Guides: To preserve alignment and pitch, supplement all loops and expansion joints with adequate guides as close to loops and joints as possible and additionally at recommended intervals from joints. Rigidly secure guides to the structure and ensure that only axial movement is permitted. Provide auxiliary support metal as required to secure guides to structure. Follow the recommendations and guidelines of the Expansion Joint Manufacturer's Association, Inc.

- D. Anchors: Install pipe anchors where required to secure the pipe and totally eliminate movement. Attach the anchors securely to the structure.
- E. Pump Connectors: Install pump connectors according to the manufacturer's recommendations and instructions. Do not use pump connectors to align pump connections with piping. Install connectors with as little initial misalignment or deflection as possible.

END OF SECTION

## SECTION 20 05 45 - HANGERS, SUPPORTS AND INSERTS

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Provide hangers, supports, concrete inserts, threaded rods, framing steel, and hardware required for piping, ductwork, and equipment installed under this Division.
- B. Install all necessary inserts, expansion shields, beam clamps, floor supports, and auxiliary steel.
- C. For new concrete installations, furnish and install concrete inserts (when used or required) for the work. Coordinate with other Contractors as appropriate.
- D. So as not to delay construction, the Plumbing, Fire Protection, and HVAC Contractors are responsible for correct locations, size, type, and installation of the concrete inserts for their work. Coordinate work with other Contractors as appropriate.
- E. Pipes 8 inches and larger in size and main racked utilities shall be supported on pipe stanchions from the floor below, unless noted otherwise. Pipe stanchions shall be constructed with pipe, tube steel or rolled section columns, base plates or pipe flanges at the floor, and top plates, saddles, or cross members as required for the intended service.
- F. The main supports shall be provided by the HVAC Contractor and shall include supports for all major, racked HVAC and plumbing piping. Drawings show general configuration and intent of support systems. Final support dimensions, locations, and pipe elevations to be set by HVAC Contractor in accordance with the Drawing Plans and Details and with coordination from all other trades. Piping supports shall be prepared and primed in accordance with the requirements of Division 5.
- G. Install wall brackets where required. Provide pipe guides and anchors as required to properly control pipe movement. Method to suit job conditions. Refer to Section 20 05 40, "Piping Expansion, Noise and Vibration Isolation."
- H. Support piping at pumps and equipment from floor, structure or walls, so that piping weight is not supported by pumps or by equipment. Install hangers with vibration isolator on all piping, ductwork, and equipment support in the room's housing mechanical equipment. See Section 20 05 80, "Vibration Isolators."

#### 1.02 QUALITY ASSURANCE

- A. All piping supports and parts shall conform to the latest requirements of the Code for Power Piping (ANSI B31.1) and MSS Standard Practice SP-58 and SP-69, except as supplemented or modified by the requirements of this Specification.
- B. Components shall be selected and matched to the load imposed on them.



- C. For ductwork supports, refer to SMACNA's "HVAC Duct Construction Standards Metal and Flexible" (latest edition).
- D. Items specified in this Section that are used for fire suppression systems shall be UL listed, FM approved and NFPA approved for the usage.

### 1.03 MANUFACTURERS

- A. Pipe Hangers: PHD, PHP, Michigan Hanger (Erico), Hilti, Kinetics, B-Line, Anvil, or Modern.

## PART 2 PRODUCTS

### 2.01 HANGERS

- A. Uninsulated Piping:
  - 1. Steel or Plastic:
    - a. 1/2 Inch to 6 Inches: PHD Fig. 151, adjustable swivel ring, steel band, adjusting nut or Fig. 450 adjustable clevis, carbon steel yoke, U-strap, bolt and hex nuts.
  - 2. Copper:
    - a. Use copper-plated hangers as specified previously for sizes up to 6 inches.
- B. Insulated Piping:
  - 1. Cast Iron (Storm), Steel, Plastic or Copper:
    - a. All piping except steam and hot water piping, all sizes: PHD Fig. 450, adjustable clevis, carbon steel yoke, U-strap, bolt, and hex nuts. Provide thermal protector.
    - b. Hot Water Piping:
      - 1) 1/2 Inch to 1 1/2 Inches: PHD Fig. 450, adjustable clevis, carbon steel yoke, U-strap, bolt, and hex nuts. Provide thermal protector.
      - 2) 2 Inches to 6 Inches: PHD Fig. 475, adjustable roller, carbon steel yoke, cast iron roll, rod, and hex nuts.
    - c. Hanger size must be sufficient to accommodate pipe and insulation without compressing insulation.
  - 2. Thermal Protector:
    - a. Insulated saddle system consisting of a factory-assembled glass-reinforced polypropylene saddle and steel pipe spacer. Assembly conductivity must be less than 0.77 btuh-in./sf-hr°F, and shall be rated for at least 40 degrees F to 200 degrees F service. Anvil Figure 260 ISS, or equal by approved manufacturer.
    - b. 6 inch long segments of 20 pcf molded fiberglass blocks Hamfab "H-block" or hardwood (oak) blocks supported by PHD Fig. 170, galvanized steel protection shield. Outdoor installations to be hardwood inserts, paraffin-coated. No softwood (pine) wood blocks or wooden dowels will be permitted. Provide a vapor barrier cover over inserts so that the insulation vapor barrier will not be broken.
- C. Sanitary and Vent Piping:
  - 1. Cast Iron: PHD Fig. 450, adjustable clevis, carbon steel yoke, U-strap, bolt, and hex nuts.
  - 2. Plastic: PHD Fig. 440, lightweight, adjustable clevis, carbon steel yoke, U-strap and bolt.

- D. Vertical Piping:
1. Cast Iron, Plastic, or Steel Piping:
    - a. 1/2 Inch to 10 Inches: Friction clamp with two point bearing, PHD Fig. 550 series at each floor level.
  2. Copper Piping: Copper-plated friction clamp with two point bearing for sizes up to 6 inches, PHD Fig. 552.

2.02 SPRING HANGERS

- A. Refer to Section 20 05 80, "Vibration Isolators."

2.03 TRAPEZE HANGERS

- A. Pre-engineered strut or angle iron of sufficient length to support pipes and insulation on individual hangers, roller supports, or saddles with insulation protectors as specified for hangers above; trapeze hanger rod diameter and quantity as required to support total piping load. Loading on any attachment point to the structure shall not exceed 1,000 lbs. Trapeze hangers are to be spaced to not exceed this maximum structural load.

2.04 SUPPORTS

- A. Hanger for Individual Pipes:

Pipe Size	Max Pipe Support Spacing Copper Tube or Plastic Pipe	Max Pipe Support Spacing Steel Pipe	Structural Attachment Based on PHD Manufacturer	PHD Hanger Figure	Rod Size based on Hanger (Larger rods may be used)
Inches	Feet	Feet			Inch
3/4 or smaller	5 - copper 3 - plastic	6	Concrete insert Fig 951 or 950 Beam Clamp Fig 270 w/ Fig 259	151 or 450	3/8
1	6 - copper 3 - plastic	7	Concrete insert Fig 951 or 950 Beam Clamp Fig 270 w/ Fig 259	151 or 450	3/8
1 1/4	6 - copper 4 - plastic	9	Concrete insert Fig 951 or 950 Beam Clamp Fig 270 w/ Fig 259	151 or 450	3/8
1 1/2	8 - copper 4 - plastic	9	Concrete insert Fig 951 or 950 Beam Clamp Fig 270 w/ Fig 259	151 or 450	3/8
2	8 - copper 4 - plastic	10	Concrete insert Fig 951 or 950 Beam Clamp Fig 270 w/ Fig 259	151 or 450 or 470 or 475	3/8
2 1/2	9 - copper 4 - plastic	10	Concrete insert Fig 951 or 950 Beam Clamp Fig 270 w/ Fig 259	151 or 450 or 470 or 475	1/2
3	10 - copper 4 - plastic	10	Concrete insert Fig 951 or 950 Beam Clamp Fig 270 w/ Fig 259	151 or 450 or 470 or 475	1/2

Pipe Size	Max Pipe Support Spacing Copper Tube or Plastic Pipe	Max Pipe Support Spacing Steel Pipe	Structural Attachment Based on PHD Manufacturer	PHD Hanger Figure	Rod Size based on Hanger (Larger rods may be used)
Inches	Feet	Feet			Inch
4	10 - copper 4 - plastic	10	Concrete attachment plate Fig 903 Beam clamp fig 350 w/Fig 359 or Fig 360 w/Fig 359	151 or 450 or 470 or 475 or 505	5/8
5	10 - copper 4 - plastic	10	Concrete attachment plate Fig 903 Beam clamp fig 350 w/Fig 359 or Fig 360 w/Fig 359	151 or 450 or 470 or 475 or 505	5/8 or 3/4
6	10 - copper 4 - plastic	10	Concrete attachment plate Fig 903 Beam clamp fig 350 w/Fig 359 or Fig 360 w/Fig 359	151 or 450 or 470 or 475 or 505	5/8 or 3/4

For fire sprinkler systems, conform to latest NFPA standards required by OBC.

**B. Beam Clamps:**

1. "C" Clamps: PHD Figs. 270 w/259, 350 w/359, 360 w/359, malleable iron body, steel pointed set screw with lock nut and a minimum of 11 gauge steel retainer strap. Beam clamps by themselves (C-clamps) are expressly prohibited. Provide retainer straps with all beam (C-Clamps). Consult with MSS SP-58 and SP-69 for C-Clamp identification.
2. PHD Fig. 930 steel washer plate, double nutted with threaded rod.

**C. Wall Brackets:** PHD Fig. 850 (lightweight 750 lbs. load) or Fig. 855 (medium weight 1,500 lb. load), carbon steel, back plates and bolts. Wall brackets for horizontal piping runs are limited to 10 inch pipe size and smaller.

**D. Pipe Supports on Roof:** Support piping on roof with an engineered prefabricated system designed for installation without roof penetrations, flashing, or damage to the roofing material. The system shall consist of bases, made of high-density polypropylene plastics with UV Protection, a hot-dipped galvanized structural steel frame and suitable pipe hangers for the application. Nuts, threaded rods, and washers shall be hot-dipped galvanized, spring nuts and bolts for spring nuts will be electro-plated. System shall be custom designed to fit piping and conduit to be installed and the actual conditions of service.

1. Bases: Injection molded high density/high impact polypropylene with UV-inhibitors and anti-oxidants, conforming to the following:
  - a. Sized as required by loading conditions and as indicated on the Drawings, shop fabricated with inserts for square tubing or threaded rods as required.
  - b. Chemical, insect, and moisture resistant.
  - c. Flammability: No ignition after 10 minutes, 25 kW/m, when tested in accordance with ASTM D 1929.
  - d. Bases for Mechanical Attachment: Sealant chamber around penetration point, with injection port for sealing after fastening; beveled lip for sealant bead around entire diameter.

2. Steel Framing:
    - a. Strut Types: 1 5/8 inch or 1 7/8 inch as required for loading conditions.
    - b. Thickness: 12 gauge.
    - c. Form: Roll-formed 3-sided or tubular shape, perforated with holes on three sides.
    - d. Finish: Hot dip galvanize in accordance with ASTM A 123 after fabrication, free of roughness, whiskers, unsightly spangles, icicles, runs, barbs, sags, droplets, and other surface blemishes.
    - e. Do not use tubing or tube steel.
  3. Pipe supports and hangers shall conform to MSS SP-58 and MSS SP-69 and as follows:
    - a. Fabricate of carbon steel where framing is carbon steel; fabricate of stainless steel where framing is stainless steel; finished same as framing.
    - b. Sizes 2 1/2 Inches and Smaller: Single roller supports for piping subject to expansion and contraction; 3-sided channels and pipe clamps.
    - c. Sizes 3 Inches and Larger: Rollers, clevis hangers, or band hangers, to allow for expansion and contraction without movement of the bases or framing and designed to reduce or eliminate the friction that would otherwise occur between the pipe and the roof membrane.
  4. Warranty: 5 year limited warranty to repair or replace any products found to be structurally defective in material or workmanship.
  5. Portable Pipe Hangers: PHP Systems and Design, or approved equal by MIRO.
- E. Attachment to Concrete Structures: PHD, Fig. 903 concrete rod attachment plate.
- F. Welded Beam Attachment: PHD, Fig. 900 concrete rod attachment plate.

## 2.05 INSERTS

- A. In Concrete: PHD, Fig. 950 wedge type insert, low carbon steel, for up to 600 lb. load.
- B. In precast or already poured concrete: Hilti "Kwik Bolt TZ" concrete fasteners, or approved equal by ITW/Redhead. "Drop-in" type fasteners are not acceptable without written evidence of third-party testing indicating there is no measurable loss of an insert's tensile capacity when concrete cracking occurs where the insert is installed.

## 2.06 FINISH

- A. Unless otherwise noted, all hangers and supports to be standard black, except that hangers and supports for exposed exterior applications and applications subject to high humidity shall be hot-dipped galvanized.

## PART 3 EXECUTION

### 3.01 PIPING INSTALLATION

- A. Install necessary pipe hangers and supports to properly support all piping and to maintain piping uniformly level or vertical (3/4 inch maximum deflection). Hangers to be double-nutted.

- B. Maximum spacing of piping supports shall be per Hanger Table included in this Specification. Provide additional hangers as follows:
1. On both sides of steel or brass, or cast metal valves for pipe sizes 6 inches and larger.
  2. Horizontal DWV Plastic Piping: At branch connections and at each change of direction.
  3. Vertical DWV Piping: At branch connections, at each change of direction, at each floor, and mid-story, for no more than a 10 foot vertical spacing. Provide additional supports as necessary to maintain piping alignment at the base.
  4. Cast Iron Piping: Horizontal at intervals not in excess of the standard lengths of pipe used; vertical 15 foot maximum intervals, at base, and at each floor.
  5. At each drop at a pump boiler, chiller or other major equipment item.
  6. Fire Protection Piping: Locate and space per NFPA requirements.

3.02 DUCTWORK HANGER INSTALLATION

- A. Install necessary hanger rods and angle iron support brackets to properly support ductwork, insulation, reinforcing, and external loads. Friction clamps are excluded as upper attachment devices.
- B. Maximum spacing of supports to be as follows:

Rectangular Ducts

1/2 x Duct Perimeter (Inches)	Rod Diameter (Inches)	Spacing (Feet)
Less than 72	3/8	10
72 to 120	3/8	8
120 to 192	1/2	5

Round Ducts

Duct Diameter (Inches)	Rod Diameter (Inches)	Spacing (Feet)
Through 24	1/4	12
25 through 36	3/8	12
37 through 50	1/2	12

1. Use a pair of rods, one (1) on each side of ductwork. Rods to be uncoated, hot-rolled steel.
2. OPTION: 1 inch wide sheet metal straps may be used on sizes up to 22 inches wide (or 22 inches in diameter), one (1) sheet metal gauge (minimum) thicker than ductwork being supported.
3. OPTION: Looped, flexible cable hanger system (Gripple Standard Hanger type) may be used on solid round duct up to 16". Installation shall comply with manufacturer recommendations for weight and spacing.

- C. Duct Supports on Roof: Support ductwork on roof with an engineered prefabricated system composed of supports with polypropylene plastic bases on roofing material to support ductwork and stations anchored to the roof structure to resist wind loads. The system shall consist of bases, made of high-density polypropylene plastics with UV Protection, a hot-dipped galvanized structural steel frame and suitable hangers for the application. Nuts, threaded rods, and washers shall be hot-dipped galvanized, spring nuts and bolts for spring nuts will be electro-plated. System shall be custom designed to fit ductwork and the actual conditions of service. Contractor is responsible for delegated design of duct support system. Basis of design is Miro Industries.
1. Bases: Injection molded high density/high impact polypropylene with UV-inhibitors and anti-oxidants, conforming to the following:
    - a. Sized as required by loading conditions and as indicated on the Drawings, shop fabricated with inserts for square tubing or threaded rods as required.
    - b. Chemical, insect, and moisture resistant.
    - c. Flammability: No ignition after 10 minutes, 25 kW/m, when tested in accordance with ASTM D 1929.
    - d. Bases for Mechanical Attachment: Sealant chamber around penetration point, with injection port for sealing after fastening; beveled lip for sealant bead around entire diameter.
  2. Steel Framing:
    - a. Strut Types: 1 5/8 inch or 1 7/8 inch as required for loading conditions.
    - b. Thickness: 12 gauge.
    - c. Form: Roll-formed 3-sided or tubular shape, perforated with holes on three sides.
    - d. Finish: Hot dip galvanize in accordance with ASTM A 123 after fabrication, free of roughness, whiskers, unsightly spangles, icicles, runs, barbs, sags, droplets, and other surface blemishes.
    - e. Do not use tubing or tube steel.
  3. Warranty: 5 year limited warranty to repair or replace any products found to be structurally defective in material or workmanship.

### 3.03 GENERAL INSTALLATION

- A. Ceiling grid system shall not be used to support ductwork, electrical conduit, heating or plumbing lines, or any other utility lines. Each utility and the ceiling grid system shall be a separate installation and each shall be independently supported from the building structure. To support ductwork or piping where interferences occur, the Contractor must install trapeze type hangers or supports that shall be located where they do not interfere with access to fire dampers, valves, and other mechanical equipment items.
- B. Where necessary, the Contractor shall furnish and install proper angles or channels for hanger supports between joists. Weld to steel structural members.
- C. Do not support hangers from roof deck.
- D. Use inserts to avoid cutting concrete or masonry. To avoid burning metal deck, use top flange beam clips.
- E. Vertical storm and waste stacks to rest firmly on masonry footings and be firmly supported at each floor.

- F. The following hanger methods are not permitted:
  - 1. Wood, lead, or plastic plugs
  - 2. Perforated band iron
  - 3. Hook chain supports
  - 4. Baling wire, etc.
  - 5. Powder-actuated anchors
- G. Whenever possible, use supports, clamps, hangers, etc., designed especially for the equipment to be installed.
- H. Where necessary, furnish and install proper angles or channels or support steel to reinforce the building structure or to spread out the load on the building structure. Weld to steel structural members or attach to concrete structures using inserts or concrete fasteners.

#### 3.04 COORDINATION

- A. Coordinate drilling, welding, etc., and method of attachment to columns, joists, beams, girts, etc., with Structural Engineer and other Contractors as appropriate before proceeding.

END OF SECTION

**Hangers for Individual Pipes ( Not SEISMIC )**

Pipe Size	Pipe Material	Weight of Pipe per Foot	Weight of Water in Pipe per Foot	Total Weight per Foot	Pipe Support Spacing Copper and plastic Pipe	Pipe Support Spacing Steel Pipe	Weight on Each Support (Max 1500 lbs)	Structural Attachment PHD Manufacturing.	Based on	Load Capacity of Attachment	Hanger PHD Fig Number	Rod Size based on Hanger (Larger rods may be used)	Load Capacity of Hanger and Rod
inches		lbs/LF	lbs/LF	lbs/LF	ft	ft	lbs			lbs		inch	lbs
3/4 or smaller	Sch 40 Steel	1.13	0.232	1.362	5	7	9.53	Concrete insert Beam Clamp Fig 951 or 950 w/ Fig 270	PHD Fig 259	400	151 or 450	3/8	300
1	Sch 40 Steel	1.68	0.375	2.055	6	7	14.39	Concrete insert Beam Clamp Fig 951 or 950 w/ Fig 270	PHD Fig 259	400	151 or 450	3/8	300
1-1/4	Sch 40 Steel	2.27	0.649	2.919	7	9	26.27	Concrete insert Beam Clamp Fig 951 or 950 w/ Fig 270	PHD Fig 259	400	151 or 450	3/8	300
1-1/2	Sch 40 Steel	2.72	0.882	3.602	8	9	32.42	Concrete insert Beam Clamp Fig 951 or 950 w/ Fig 270	PHD Fig 259	400	151 or 450	3/8	300
2	Sch 40 Steel	3.65	1.454	5.104	8	10	51.04	Concrete insert Beam Clamp Fig 951 or 950 w/ Fig 270	PHD Fig 259	400	151 or 450 or 470 or 475	3/8	150
2-1/2	Sch 40 Steel	5.79	2.073	7.863	9	11	86.49	Concrete insert Beam Clamp Fig 951 or 950 w/ Fig 270	PHD Fig 259	400	151 or 450 or 470 or 475	1/2	225
3	Sch 40 Steel	7.58	3.201	10.781	10	12	129.37	Concrete insert Beam Clamp Fig 951 or 950 w/ Fig 270	PHD Fig 259	400	151 or 450 or 470 or 475 or 505	1/2	310
3-1/2	Sch 40 Steel	9.11	4.287	13.397	12	12	160.76	Concrete insert Beam Clamp Fig 951 or 950 w/ Fig 270	PHD Fig 259	400	151 or 450 or 470 or 475 or 505	1/2	390
4	Sch 40 Steel	10.79	5.516	16.306	12	12	195.67	Concrete Attachment plate Fig 903 Beam Clamp Fig 350 w/ Fig 359 or Ffig 360 w/ Fig 359		600	151 or 450 or 470 or 475 or 505	5/8	475
5	Sch 40 Steel	14.62	8.674	23.294	12	12	279.53	Concrete Attachment plate Fig 903 Beam Clamp Fig 350 w/ Fig 359 or Ffig 360 w/ Fig 359		800	151 or 450 or 470 or 475 or 505	5/8 or 3/4	685
6	Sch 40 Steel	18.97	12.520	31.490	12	12	377.88	Concrete Attachment plate Fig 903 Beam Clamp Fig 350 w/ Fig 359 or Ffig 360 w/ Fig 359		2710	151 or 450 or 470 or 475 or 505	5/8 or 3/4	780
8	Sch 40 Steel	28.55	21.680	50.230	12	12	602.76	Concrete Attachment plate Fig 903 Beam Welded Attachment Fig 900		3770	151 or 450 or 470 or 475 or 505	7/8	780
10	Sch 40 Steel	40.48	34.160	74.640	12	12	895.68	Concrete Attachment plate Fig 903 Beam Welded Attachment Fig 900		3770	151 or 450 or 470 or 475 or 505	7/8	965
12	Sch 40 Steel	53.52	48.500	102.02	12	10	1020.20	Concrete Attachment plate Fig 903 Beam Welded Attachment Fig 900		3770	151 or 450 or 470 or 475 or 505	7/8	1200



Hangers for Individual Pipes ( Not SEISMIC )													
Pipe Size	Pipe Material	Weight of Pipe per Foot	Weight of Water in Pipe per Foot	Total Weight per Foot	Pipe Support Spacing Copper and plastic Pipe	Pipe Support Spacing Steel Pipe	Weight on Each Support (Max 1500 lbs)	Structural PHD Manufacturing.	Attachment Based on	Load Capacity of Attachment	Hanger PHD Fig Number	Rod Size based on Hanger (Larger rods may be used)	Load Capacity of Hanger and Rod
inches		lbs/LF	lbs/LF	lbs/LF	ft	ft	lbs			lbs		inch	lbs
14	Sch 40 Steel	63.44	58.640	122.08	12	9	1098.72	Concrete Attachment plate Fig 903	Beam Welded Attachment Fig 900	4960	450 or 470 or 475	1	1200
16	Sch 40 Steel	82.77	76.580	159.36	12	7	1115.45	Concrete Attachment plate Fig 903	Beam Welded Attachment Fig 900	4960	450 or 470 or 475	1	1200
18	Sch 40 Steel	104.67	96.930	102.6	8	6	1209.60	Concrete Attachment plate Fig 903	Beam Welded Attachment Fig 900	6230	450 or 470 or 475	1 or 1-1/8	1400
20	Sch 40 Steel	123.11	120.46	243.57	8	6	1461.42	Concrete Attachment plate Fig 903	Beam Welded Attachment Fig 900	8000	450 or 470 or 475	1-1/4	1600
24	Sch 40 Steel	171.29	174.23	345.52		4	1382.08	Concrete Attachment plate Fig 903	Beam Welded Attachment Fig 900	8000	450 or 470 or 475	1-1/4 or 1-1/2	1600
30	Sch 30 Steel	196.08	281.4	477.48		8	3819.84	Concrete Attachment plate Fig 903	Beam Welded Attachment Fig 900	8000	450 or 480	1-1/4 or 1-1/2	6000
36	Sch 40 Steel	282.35	405.24	687.59		8	5500.72	Concrete Attachment plate Fig 903	Beam Welded Attachment Fig 900	11630	450	1-1/2	9500

## SECTION 20 05 50 - GENERAL PIPING REQUIREMENTS

### PART 1 GENERAL

#### 1.01 PIPING SYSTEMS - GENERAL

- A. The following instructions apply to all piping systems, except where otherwise noted:
  - 1. Provide unions, flanges, or grooved ends at each final connection and at each piece of equipment. Arrange piping and locate unions, flanges, and grooved ends to permit easy removal of parts and equipment for inspection and cleaning. Welded connections to equipment are prohibited.
  - 2. Make connections to equipment as detailed on the Drawings and according to the manufacturer's installation instructions.
  - 3. Where connection size is smaller than piping make reduction at final connection only (do not reduce size of pipe drop).
  - 4. Provide valves and specialties as required to complete installation of each piece of equipment for proper operation.
  - 5. Install all piping parallel to building lines, level and plumb unless required to slope.
- B. Cleanout and flush water piping systems.
- C. If other means of draining are not provided, install drain valves at all low points to permit complete draining of each of the following:
  - 1. All water systems
  - 2. Compressed air systems
  - 3. Fire sprinkler systems (according to NFPA)
- D. Contractor to provide information on chases, sleeves, and openings required for his/her work to other Contractors. This Contractor to assume cost and responsibility for all cutting and patching resulting from improper coordination of the work.
- E. Certified Pipe Welding Bureau. Welds to be stamped at each joint or fitting.
- F. Install dielectric unions at all connections of dissimilar metals.

### PART 2 PRODUCTS

#### 2.01 UNIONS

- A. Unions in Copper Pipe: Bronze 150 lb. ground joint, cast body, solder end (do not use wrought copper unions). Mueller, Chase, Crane, or Northern Indiana Brass Company.
- B. Unions in Steel Pipe: Black malleable iron, bronze ground ball joint. Mueller, Chase, Crane, or Northern Indiana Brass Company.

- C. Dielectric unions when connecting steel to copper pipe: 250 lb. W.P., insulating gasket, and dielectric insulators. Epco, Dart, Capital, or Watts.
- D. Dielectric fittings on flanges when connecting flanges on piping of dissimilar metals: 175 psig W.P., insulating gaskets, dielectric insulators including bolt isolators.

## 2.02 JOINTS

- A. Flanges:
  - 1. Through 2 1/2 Inches: Cast iron screwed, 125 lb. or higher as required.
  - 2. 3 Inches and Larger: Steel welding neck, 150 lb. or higher as required.
- B. Gaskets: Asbestos-free, suitable for the intended service. Use dielectric gaskets where joining dissimilar piping material.
- C. Bolts for steel, cast iron, brass, and bronze, for 250 lb. SWP and 450 degrees F or below to be carbon steel, with American Standard, regular, square heads and American Standard, heavy, hexagon grade or better semi-finished nuts.
- D. ASTM A307, Grade B, Tee head, high-tensile steel bolts and nuts may be used in mechanical joint pipelines. (Mechanical joints are not to be used with tubing of copper or aluminum alloys.)
- E. Screwed Piping: Use NPT tapered threads.

## 2.03 GROOVED PIPING

- A. Where grooved piping systems are allowed by reference in other Sections within this Specification, the installing Contractor must have installed at least five (5) grooved mechanical piping systems.
- B. Install grooved couplings on 2 inch – 24 inch roll-grooved, standard weight Schedule 40 pipe in accordance with the coupling manufacturer's installation instructions. Cut-grooved piping systems will be unacceptable.
- C. Install flexible couplings with the bolt pads metal to metal; rigid (slant bolt pad) couplings shall be installed within the bolt pads metal to metal with equal offset. Installing Contractor shall verify that bolt pad gaps do not exist.
- D. The grooved mechanical coupling manufacturer shall perform on-site installation demonstrations for the Installing Contractor before grooved coupling installation begins.

## 2.04 COPPER PRESS JOINT JOINING SYSTEM

- A. Where such copper press joint piping systems are allowed by reference in other Sections within this Specification, and if permitted by local authorities, the installing Contractor must have installed at least five of such mechanical piping systems.
  - 1. Copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.
  - 2. All piping shall be Type "L" copper. Fittings 1/2 inch to 4 inches shall be crimped on both sides of an integral bead containing an EPDM seal. Fittings 2 1/2 inches through 4 inches shall be double crimped, and be fitted with a stainless steel grip ring.
  - 3. The Contractor shall be trained on the installation of the product by the manufacturer and shall follow the manufacturer's installation instructions.
  - 4. The copper tubing system shall be water tested for joint tightness. The piping system shall be filled with water. The system shall be pressurized to the maximum pressure and length of time required by the code or standard. The system shall have no leaks at the rated pressure.
  - 5. Valve joining method shall comply with requirements of Section 22 05 23, "Plumbing Valves" or 23 03 23, "HVAC Vales". Valves using the Press Joint Joining System are not acceptable.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install each union or flange to permit removal of parts, valves, and equipment and in a position permitting the device or equipment to be removed without disconnecting piping. Use flanged equipment connections exclusively on all steam and condensate systems.
- B. Make reductions in piping lines with reducing coupling or weld fitting reducer. No bushings will be permitted.
- C. Install piping to provide clearance for personnel passage, headroom, operation of doors or windows, equipment, lighting outlets, and for the Owner's apparatus and equipment. Coordinate pipe runs and elevations with other Contractors before installation. Where interferences develop in the field, pipes may need to be offset or rerouted, at no additional cost to the Owner, as required to resolve interferences.
- D. In pipe spaces to be entered for servicing, offset piping so that all lateral runs are located either near the floor or at least 6 feet above the floor, and all vertical piping is held close to the wall through that height. Keep all piping to the side of the chase wherever possible. Offset vents immediately above the connection to the waste line.
- E. Piping shall not be installed over electrical equipment, motor control centers, or transformers and shall not be installed within elevator shafts or elevator equipment rooms.

- F. Install pipes, valves, fittings, etc. with a minimum of 1/2 inch clearance between the finished covering and other work and between the finished covering of parallel, adjacent pipes.
- G. Use fittings to make changes in pipeline direction. Do not bend or spring piping.
- H. Offset lines around columns, beams, and other obstructions as required. Where special conditions are encountered in the field, arrangement and alignment of piping shall be decided by the Architect and Engineer.
- I. At time of assembly, clean piping components of loose material. After assembly and before putting in service, blow or flush lines free of loose materials. Clean strainer screens and sediment pockets prior to putting the lines in service.
- J. Install valves at service connections to equipment and branch lines from main lines. Install all valves and unions so that they are accessible through ceiling or wall access panel.
- K. Use dielectric unions, shims, gaskets, or coatings to insulate direct contact between pipe, fittings, and hangers of dissimilar metal
- L. Install thermometers and gauges to permit them to be read from floor level.
- M. Securely support all piping from structure with approved hangers, rods, brackets, and accessories.
- N. Where piping is installed in new masonry block walls, coordinate other Contractors as appropriate so that piping extends out through a masonry joint where possible.
- O. Bullhead connections are not allowed.
- P. Where exposed pipes pass through walls, floors, or ceilings of finished rooms, provide chrome-plated escutcheons. Prime-coated black iron escutcheons may be used in unfinished rooms. Protect escutcheons from tool marks.
- Q. Keep pipe level except where a slope is required. Use eccentric reducers to keep bottom of pipe level.
- R. Avoid trapping of piping.
- S. Install ball valves at pressure gauges and air vents at high points of piping.
- T. Provide a union or bolted flange fitting downstream and within approximately 12 inches of each valve and adjacent to both inlet and outlet of pumps and other equipment.
- U. When copper lines are supplied, install dielectric unions or flanges on water line connections to water heaters and equipment with steel pipe connections.
- V. Provide unions or flanged connections where required for construction or assembling purposes.

3.02 WELDED CONNECTIONS

- A. Welded joints to be fabricated and stamped by welders qualified and certified for the positions, materials, methods, and equipment being used and as required by enforcing bodies.
- B. Buttweld joints shall have substantially full penetration and recommended bead reinforcement.
- C. Slip-on, socket, and fillet welds to have geometry indicated in the "Code for Power Piping" (ANSI B31.1).
- D. Remove weld scale from joints as work proceeds and at completion.

3.03 SOLDERED AND BRAZED CONNECTIONS

- A. Joints to have pipe or tubing end reamed to full I.D. after cutting.
- B. Exterior of joint shall be smooth.
- C. Clean with steel wool.
- D. Apply flux to prevent oxidation.
- E. Apply solder or brazing filler material and thoroughly heat to completely melt material and cause it to migrate completely over the mating surfaces.
- F. Solder and brazing work shall comply with ANSI Standard B31.1.
- G. Valve joining method shall comply with requirements of Section 22 05 23, "Plumbing Valves" or 23 03 23, "HVAC Vales". The use of soldered or brazed joints on valves is not acceptable.

3.04 THREADED CONNECTIONS

- A. Ream pipe ends of threads to full cross sectional area after cutting. Threads shall conform to ANSI Standard B2.1.
- B. Joints shall be made with TFE tape, applied to male threads only. Option: Use Permatex pipe dope.

3.05 FLANGED CONNECTIONS

- A. Face flanged joints square and true. Install gaskets suitable for the operating temperature and pressure of the fluid or gaseous medium being piped.

### 3.06 PIPE CLEANING

- A. Before systems are placed in operation, flush out all water piping systems to remove dirt and grease from pipes and equipment. Clean strainers after each flushing until they remain clean.
- B. For heating and cooling water piping systems, after system has been flushed thoroughly and drained, perform the following steps:
  - 1. Completely fill and circulate through system for four (4) hours at design temperature with a solution of Burman "Pre-Clean."
  - 2. Completely drain and refill system with fresh clean water.
  - 3. Check pH and continue cleaning as recommended by Burman.
- C. Fire protection mains to be flushed at flows required by NFPA-13 and NFPA-24.
- D. For steam piping systems, after system is placed in operation, dump condensate for 24 hours before returning condensate to boiler.

### 3.07 PIPING PROHIBITIONS

- A. Do not run piping over electrical equipment, across windows, door openings, access panels or lighting fixtures or within 36 inches in front of electrical panels that operate at a voltage of 150 volts or less, or within 42 inches of electrical panels that operate at a voltage of 151 to 600 volts. Obtain instructions from the Architect if a conflict occurs. Coordinate with the Electrical Contractor.
- B. On any given system, the Contractor will not be permitted to mix and join different types of pipe material. For example, if a storm or sanitary system uses plastic, copper, and cast iron, the Contractor may change from one to the other only once. The line may not be changed back to the first material further downstream.
- C. Storm, vent and sanitary lines shall be continuously sloped; trapping is expressly prohibited.

### 3.08 EMBEDDED PIPING LIMITATIONS

- A. Install embedded pipes and sleeves subject to the following limitations:
  - 1. Do not embed aluminum without prior approval of coating material.
  - 2. Do not displace reinforcing steel.
  - 3. In slabs and walls, limit outside dimension of pipes to 1/3 member thickness. Minimize crossing embedded piping, and where crossing cannot be avoided, maintain same minimum concrete cover as required for reinforcing bars. For slabs over metal decks, slab thickness is measured from the top of the metal deck.
  - 4. In columns, limit total area of pipes to 4% of column area.
  - 5. Maintain a center-to-center spacing of at least three diameters of pipe or sleeve.
  - 6. Do not install sleeves or piping in any concrete beam, unless specifically shown on the structural Drawings.

END OF SECTION

SECTION 20 05 55 - VALVE TAGGING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Provide valve tags on all HVAC, Plumbing, and Fire Protection valves including control valves. Stamp tags with service designation and number tags consecutively for each system. Coordinate numbering with any existing valve tag schedules and with the Owner.
- B. Prepare a typewritten valve tag directory with charts showing locations, designations, and sizes of valves. Laminate under plastic and mount as directed by the Architect. Include additional copies of valve charts in the Service Manuals.

1.02 COORDINATION

- A. Coordinate with all other Contractors to ensure that the valve tagging used by all Trades is uniform in type, style, and appearance.

1.03 MANUFACTURERS

- A. Brady, Seton, Kolbi, EMED, MSI, or Brimar.
- B. All valve tags used on the project shall be same type, shape, and lettering and be made by the same manufacturer. Coordinate with all other Contractors.

PART 2 PRODUCTS

2.01 TAGS

- A. 2 inch diameter, 16 gauge, brass tag with brass chain. 1/4 inch high stamped letters over 1/2 inch high stamped numbers, both black-filled.
- B. Furnish and install color-coded tags to indicate concealed valve locations. Attach color-coded tags to the ceiling T-bars. Match tag colors to the color of the pipe band specified.

2.02 IDENTIFICATION SCHEDULE

- A. Identify as follows:

	Type of Service	Valve Tag Designation
PLUMBING	Domestic cold water	DCW
	Domestic hot water	DHW
	Domestic hot water return	DHWR
	Natural gas	GAS
	Compressed air	CA



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	Type of Service	Valve Tag Designation
FIRE PROTECTION	Wet pipe sprinkler system	SPR
HVAC	Heating water supply	HWS
	Heating water return	HWR
	Refrigerant suction	S
	Refrigerant liquid	L
	Refrigerant hot gas	HG
	Temperature control valves	(Varies)

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### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Tags:
1. Attach to valve handwheels.
  2. Locate to be easily readable from standing position when valve is in normal position.

END OF SECTION

SECTION 20 05 65 - EQUIPMENT, PIPING, AND DUCTWORK IDENTIFICATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Identify by labels and tags the following items:
  - 1. Equipment such as pumps, air handlers, fans, unit heaters, control cabinets, and similar items.
  - 2. Piping and ductwork exposed in equipment rooms and accessible service areas.
  - 3. Piping and ductwork above accessible ceiling construction and near access panels in non-accessible ceiling construction.
  - 4. Piping in crawl spaces.
- B. Install laminated plastic nameplates for equipment, and install color banding, flow arrows, and contents identification for piping.

1.02 COORDINATION

- A. Coordinate with other Contractors to ensure that the identification used by all Trades is uniform in type, style, and appearance.
- B. Coordinate all identification systems with any already existing.

1.03 MANUFACTURERS

- A. Brady, Seton, Kolbi, Graphic Products, CALPICO, EMED, MSI, or Brimar.

PART 2 PRODUCTS

2.01 EQUIPMENT IDENTIFICATION

- A. Engraved laminated plastic, white over black, sized for 3/4 inch high letters or numbers, Gothic style.

2.02 PIPING AND DUCTWORK IDENTIFICATION

- A. Provide vinyl adhesive labels or vinyl wrap-around markers. Match label background color to 2 inch color band.

- B. Size to be as follows:

Outside Diameter of Pipe or Covering	Minimum Letter Height
3/4" to 1-1/4"	1/2"
1-3/8" to 2"	3/4"
2-1/8" to 7-7/8"	1-1/4"
8" to 10"	2-1/2"
Over 10"	3-1/2"

2.03 COLOR BANDS

- A. Provide 2 inch wide (minimum) painted gloss enamel or vinyl tape color band on each pipe, completely wrapping the pipe circumference. See "Identification Schedule" for band color.

2.04 FLOW ARROWS

- A. Provide color-coded adhesive vinyl flow arrow on each pipe, secure flow arrows to pipe at each end of flow arrow with a color band, completely wrapping the pipe circumference. Match flow arrow color with color band.

- B. Size to be as follows:

Outside Diameter of Pipe or Covering	Minimum Flow Arrow Size
3/4" to 1-1/4"	1-1/8" by 4"
1-3/8" to 2"	1-1/2" by 4"
2-1/8" to 7-7/8"	2-1/4" by 6"
8" and over	4" by 7"

- C. In lieu of separate flow arrows, flow arrows may be incorporated into color bands. See "Identification Schedule" for band color, and match flow arrow color lettering color.

2.05 IDENTIFICATION SCHEDULE

- A. Identify as follows:

Type of Service	2 Inch Color Band and Label Color	Lettering Color	Designation
FIRE PROTECTION			
Sprinkler	Red	White	SPR
Drain	Red	White	D
Dry pipe	Red	White	DP

Type of Service	2 Inch Color Band and Label Color	Lettering Color	Designation
<b>PLUMBING</b>			
Domestic cold water	Green	White	DCW
Domestic hot water	Yellow	Black	DHW
Domestic hot water return	Yellow	Black	DHWR
Natural gas	Yellow	Black	GAS
Storm	Green	White	STM
Emergency storm	Green	White	E-STM
Sanitary	Yellow	Black	SAN
Vent	Yellow	Black	V
Compressed air	Blue	White	CA
<b>HVAC</b>			
Heating water supply	Yellow	Black	HWS
Heating water return	Yellow	Black	HWR
Air conditioner condensate	Green	White	COND
Refrigerant hot gas	Yellow	Black	HG
Refrigerant liquid	Yellow	Black	L
Refrigerant suction	Yellow	Black	S
<b>HVAC DUCTWORK</b>			
Supply air	Blue	White	Supply
Return air	Blue	White	Return
Exhaust air	Yellow	Black	Exhaust
Relief air	Blue	White	Relief
Outside air	Blue	White	Outside Air

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Attach equipment tags with screws. Exception where screws might damage equipment or ductwork, use compatible adhesive instead of screws.
- B. Apply piping and ductwork identification only after finish painting is completed.
- C. Provide service designations, flow arrow, and color banding at intervals of 15 feet (maximum).
- D. Also identify piping at connections to equipment, at entrances to spaces, at valves, near access doors to pipe spaces, at branches from main, at each riser, and at both sides of the wall or barrier through which the piping passes.
- E. Clean piping, duct, or insulation in area of labeling just before labeling of pipe, duct, or insulation.
- F. Ensure that labels are readable from a normal standing position.

END OF SECTION

## SECTION 20 05 70 - DEMOLITION

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Carefully inspect the entire project and verify with the Architect all items designated to be removed or to remain. Refer also to Division 1 for additional requirements.
- B. Perform demolition work of all Plumbing, Fire Protection, and HVAC items as shown or described on the Drawings. Remove from the site all items designated as scrap.
- C. Locate all existing utilities requiring removal and determine all requirements for disconnecting and capping.
- D. Locate all existing active utilities designated to remain and determine the requirements for their protection.
- E. Take care not to damage adjacent construction designated to remain.
- F. Unless otherwise noted, carefully remove existing ceiling tiles and supporting structure as required to install or remove existing material and replace after work is completed. Any damaged ceiling tiles and supporting tiles shall be replaced by each Contractor at no additional cost to the Owner.
- G. All demolished Plumbing, Fire Protection, and HVAC items in good condition are to remain the property of the Owner. Verify with the Owner's representative which demolished items are considered scrap and are to be removed from site.

### PART 2 PRODUCTS (NOT APPLICABLE)

### PART 3 EXECUTION

#### 3.01 PREPARATION

- A. Notify the Architect at least two (2) full working days prior to commencing work in a particular area.
- B. Coordinate and schedule all work in a careful manner with all necessary consideration for the Owner, neighbors, and the public. Avoid interference with the use of, and passage to and from, adjacent areas and facilities designated to remain in use during demolition. Coordinate work with the other Contractors and Owner.
- C. Before starting site operations, disconnect or arrange for the disconnection of all utilities or equipment designated to be removed. Perform all such work in accordance with the requirements of the utility company and the Owner.

- D. Maintain in operating condition all active utilities designated to remain.

### 3.02 DEMOLITION

- A. Demolish and remove equipment foundations and supports, piping, ductwork, abandoned utility lines, and all other existing items designated for removal as indicated on the Drawings and in these Specifications.
- B. Do not use equipment or methods that will cause damage to adjacent construction designated to remain.
- C. Plug or cap piping that Drawings or Specifications indicate will remain.
- D. Plug or cap wall and floor sleeves not being reused. Refer to Section 20 05 35, "Sleeves, Seals, and Firestops."
- E. Cap removed branch ducts close to mains with 24 gauge galvanized sheet metal.

### 3.03 RELOCATION

- A. Remove and store until the construction is ready for their installation, all items designated to be relocated.
- B. Clean all Plumbing, Fire Protection, and HVAC fixtures and equipment designated to be relocated after relocation is complete.

### 3.04 SALVAGE AND SCRAP

- A. Maintain salvaged materials in good condition. Salvaged materials shall remain the property of the Owner. Salvaged materials not acceptable to the Owner shall be considered scrap and removed by the Contractor from the job site.
- B. Tag and identify salvaged materials.
- C. Coordinate with Owner's representative all Plumbing, Fire Protection, and HVAC items to be salvaged and stored on site as directed. Storage of salvaged items will be permitted only at specified areas. Provide weather covering of stockpiled salvage materials. The Owner shall remove salvaged and stored items from the site.
- D. Remove all scrap items from the building and arrange for disposal in accordance with State and local regulations.

### 3.05 EXISTING EQUIPMENT TO REMAIN

- A. Clean all Plumbing, Fire Protection, and HVAC fixtures and equipment designated to remain in the areas of construction.

3.06 HAZARDOUS MATERIALS

- A. Contractors are cautioned to check premises for existence of hazardous materials such as paint with lead and asbestos in the form of pipe insulation or plaster. If materials that may present a health hazard to workers, occupants, or the public are encountered during the work, the Contractor shall do the following:
1. Take immediate action to limit the exposure or hazardous condition.
  2. Cease work in the area until suspected hazardous material can be identified. Laboratory testings, if required, will be paid for by the Owner.
  3. Follow procedures and requirements of the governing authority (including, but not limited to, EPA and OSHA) regarding monitoring, removal and disposal of the hazardous material. Provide special equipment as required.
  4. Costs relating to special work or procedures used or required for performance of the work required to monitor, remove and dispose of hazardous materials will be borne by the Owner.

END OF SECTION

SECTION 20 05 71 - DEMOLITION OF SYSTEMS CONTAINING REFRIGERANTS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Perform demolition work of all refrigerant system.
- B. Demolition of HVAC equipment containing any refrigerant shall be in compliance with Section 608 Refrigerant Recycling Rule of the Clean Air Act of 1990.
- C. All demolished HVAC items are considered scrap and are to be removed from site.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 DISPOSAL OF AIR-CONDITIONING AND REFRIGERATION EQUIPMENT

- A. Contractor shall maximize recovery and recycling of ozone-depleting substances both chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) during the disposal of air-conditioning and refrigeration equipment.
- B. Contractor shall require technicians disposing air-conditioning and refrigeration equipment to certify to EPA that they have acquired refrigerant recovery equipment and are complying with the requirements of the Section 608 Refrigerant Recycling rule.
- C. Refrigerants shall be reclaimed by an EPA certified refrigerant reclaimer.
- D. Refrigeration and air-conditioning equipment that is dismantled on-site before disposal shall have the refrigerant recovered in accordance with EPA's requirements for servicing prior to their disposal.

END OF SECTION



## SECTION 20 05 80 - VIBRATION ISOLATORS

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Provide a complete vibration isolation system to isolate motorized equipment, piping, ductwork, and appurtenances from the building structure and ceiling construction.
- B. Include concrete for inertia bases.
- C. Provide vibration isolation devices with motion limiters, sway struts, limits stops, shock absorbing devices, and/or snubbers to control the horizontal and vertical movement of equipment during seismic events. These devices shall be supplied based on the seismic design data included in the other sections of this specification or listed on the drawings. This data includes Site Class, Seismic Design Category, and Design Spectral Response Acceleration for short period.

#### 1.02 QUALITY ASSURANCE

- A. Expected noise levels in various parts of the building shall conform to noise criteria recommendations as set forth in the current edition of ASHRAE Guide and Fundamentals. The midpoint of the range of noise criteria curves shall apply and become part of these Specifications.
- B. Sound and vibration control design criteria for mechanical systems for this building shall conform to the chapter in Sound and Vibration Control in the current edition of ASHRAE Guide, HVAC Systems and Applications.
- C. Vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.

#### 1.03 MANUFACTURERS

- A. Kinetics, Korfund Dynamics Corporation, Vibration Eliminator Company, Inc., Vibration Mountings and Controls, Inc., or Mason Industries, Inc.

### PART 2 PRODUCTS

#### 2.01 VIBRATION ISOLATORS

- A. Type 1 - Pad Mounts: Precompressed molded fiberglass isolation pads, neoprene jacketed and stabilized during manufacturing. Pads shall be sized for loading from 40 to 60 psi.
  - 1. Kinetics Model KIP

- B. Type 2 - Hanger Mounts: Vibration isolators with maximum static deflection requirements under the operating load conditions not exceeding 0.40 inch shall be hangers consisting of an elastomer-in-shear insert encased in a welded steel bracket and provided with a stamped load transfer cap. The elastomer insert shall be neoprene, molded from oil resistant compounds, and shall be color coded to indicate load capacity and selected to operate within its published load range. The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30 degree arc without metal-to-metal contact or other short circuit.
1. Kinetics Model RH
- C. Type 3a - Spring Hanger Mounts: Vibration isolators shall be hangers consisting of a freestanding, laterally stable steel spring and elastomeric washer in series, assembled in a stamped or welded steel bracket. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be selected to provide operating static deflections shown on the Vibration Isolation Schedule or as indicated on the project documents. Springs shall be color coded or otherwise identified to indicate load capacity.
1. Kinetics Noise Control Type SH
- D. Type 3b - Spring Hanger Mounts: Vibration isolators where both high and low frequency vibrations are to be isolated, shall be hangers consisting of a laterally stable steel spring in series with a pre-compressed molded fiberglass insert, complete with load transfer plates and assembled in a stamped or welded steel bracket. Vibration isolators shall be pre-compressed molded fiberglass pads individually coated with a flexible, moisture impervious elastomeric membrane. Vibration isolation pads shall be molded from glass fibers with fiber diameters not exceeding 0.00027 inches and with a modulus of elasticity of 10.5 million PSI. Natural frequency of fiberglass vibration isolators shall be essentially constant for the operating load range of the supported equipment. Vibration isolators shall be color coded or otherwise identified to indicate the load capacity. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be selected to provide operating static deflections shown on the Vibration Isolation Schedule or as indicated on the project documents. Springs shall be color coded or otherwise identified to indicate load capacity.
1. Kinetics Noise Control Type SFH
- E. Type 3 - Spring Floor Mounts: Vibration isolators shall be freestanding, unhooused, laterally stable springs wound from high strength spring steel. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be selected to provide operating static deflections shown on the Vibration Isolation Schedule or as indicated on the project documents. Springs shall be color coded or otherwise identified to indicate load capacity. In capacities up to 5,000 lbs., springs shall be replaceable. In capacities over 5,000 lbs., springs shall be welded to the top and bottom load plate assemblies. Springs shall be assembled between a top and bottom steel load plate. The upper load plate shall be provided with a steel leveling bolt lock nut and washer for attachment to the supported equipment. The lower load plate shall have a non-skid noise isolation pad bonded to the bottom and have provisions for bolting the isolator to the supporting structure.
1. Kinetics Noise Control Type FDS

- F. Type 4 - Spring Limit Floor Mounts: Similar to Type 3 Spring Floor Mounts, but include neoprene and steel vertical limit stops to assure a constant spring mount. Vibration isolators shall consist of large diameter laterally stable steel springs assembled into formed or welded steel housing assemblies designed to limit vertical movement of the supported equipment. Housing assembly shall be formed or fabricated steel members and shall consist of a top-load plate complete with adjusting and leveling bolts, vertical restraints, isolation washers and a bottom plate with non-skid noise stop pads and holes provided for anchoring to supporting structure. Housing shall be hot dipped galvanized. Make provisions to prevent mechanical short-circuiting by isolating the limit stops.
  - 1. Kinetics Noise Control Type FLS.
- G. Type 5 - Thrust Restraints: Spring-loaded restraint with 1 inch deflection, installed in pairs to limit movement associated with equipment thrust.
  - 1. Kinetics Model HSR
- H. Type A - Structural Base: No additional base is provided. The isolators are attached directly to equipment that has been designed for adequate structural rigidity.
- I. Type B - Structural Base: Welded structural steel frame base, individually designed and engineered by the manufacturer to support mechanical equipment and allow the use of vibration isolators. Provide main steel numbers with section depths of 3 to 12 inches. Complete with outboard isolator brackets and prelocated equipment anchor bolts.
  - 1. Kinetics Model SFB
- J. Type C - Inertia Bases:
  - 1. Reinforced concrete inertia base with welded steel channel frame with prelocated equipment anchor bolts and welded templates, 1/2 inch diameter rebars, 8 inches O.C. each way, isolator mounting brackets, base thickness greater than 8% of span between isolators or as indicated on the Drawings, length and width as required to control size and weight of equipment being isolated, including pipe elbows connected to pumps.
  - 2. Kinetics Model CIB
- K. Type D - Roof Curb Isolation Rails: Prefabricated extruded aluminum rail system incorporating 1 inch deflection freestanding stabile springs for vibration isolation and a continuous foam neoprene air and water seal. The aluminum rail shall include an integral slot anchoring springs to the bottom section, but allowing horizontal adjustment.
  - 1. Kinetics Model KSR-2

2.02 ISOLATOR SCHEDULE

- A. Furnish isolator types as follows:

Equipment Item	Base Type	Isolator Type	Deflection (Inches)
Small suspended fans	---	3a	0.75
Large suspended fans	---	3b	0.75
Unit heaters	---	3a	0.50
Air cooled condenser	A	4	0.25

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Equipment Item	Base Type	Isolator Type	Deflection (Inches)
Piping	---	3b	0.50
Ductwork	---	3a	0.50

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2.03 MASS-LOADED VINYL WRAP

- A. Limp, reinforced loaded vinyl with lead-free and asbestos-free fillers, with high-strength polyester fabric reinforcement, 1 lb. per square foot face weight. Material shall have a continuous operating range of -40 degrees F to +180 degrees F, and shall be resistant to water, oil, weak acids, alkalies, mold, and fungi. Material shall not rot, shrink or cause metal corrosion. Provide Class A fire-rating where required.
- B. Type KNM-100 by Kinetics, or equal by other listed manufacturers.

2.04 SEISMIC

- A. Provide sway struts, limits stops and/or shock absorbing devices to control the movement of equipment during seismic events. Each equipment manufacture shall designate the required restraints for the specific equipment items being supplied based on equipment construction and required seismic restraint. The equipment and the restraints, as a combined assembly, are to be tested or analysis and a certificate of compliance for both the restraints and the equipment item shall be provided. The testing and/or dynamic analysis methods shall comply with the building code requirements.

PART 3 EXECUTION

3.01 PREPARATION

- A. Use steel components that are phosphated and painted. Use only nuts, bolts, and washers that are zinc-electroplated.
- B. Thoroughly clean structural steel bases of welding slag and prime them with zinc-chromate or metal etching primer.
- C. All isolators exposed to the weather, located outdoors, or within manholes or tunnels shall have all steel parts either PVC-coated or hot-dip galvanized.
- D. Use aluminum components that are etched and painted.

3.02 INSTALLATION

- A. Equipment: All motorized heating and air-conditioning equipment, including pumps, fans and other equipment, shall be mounted on, or suspended with, vibration isolators.

- B. Piping and Ductwork:
1. All piping over 1 inch outside diameter located in mechanical equipment rooms shall be isolated from the building structure by means of noise and vibration isolation hangers. The only exclusions are roof and floor drain piping, and all sprinkler piping.
  2. All piping located less than 50 feet (or 100 pipe diameters - whichever is greater) from any connection to vibration isolated mechanical or electrical equipment, shall be isolated from the building structure by means of noise and vibration isolation hangers. All piping in the building, which is connected to vibration-isolated equipment, shall be isolated at these connections to the building structure.
  3. All ductwork located in mechanical equipment rooms, and for a minimum of 50 feet from any connection to vibration-isolated air moving equipment shall be isolated from the building structure by means of noise and vibration isolation guides and supports.
  4. Isolate all ductwork vertical risers from the building structure by means of noise and vibration isolation guides and supports.
  5. Use vibration and noise isolating expansion hangers to isolate vertical pipe risers from the structure. The hangers shall have a minimum rated deflection of four times the anticipated pipe expansion and shall be enclosed in a housing for fail-safe operation.
  6. All piping and ductwork to be isolated according to this Section of the Specifications shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved or otherwise formed to allow passage of piping or ductwork, and maintain a minimum of 3/4 inch and maximum of 1 1/4 inches clearance around the outside surfaces. This clearance space shall be tightly packed with 1.58 PCF glass fiber and shall be caulked airtight after installation of the piping or ductwork, to form an acoustic seal.
- C. The installed vibration isolation system for each floor or for ceiling supported equipment shall have a maximum lateral motion under equipment start-up or shutdown conditions of 1/4 inch. Motions in excess shall be restrained by approved spring-type thrust restraints as specified or approved by submittal Drawing.

END OF SECTION

SECTION 20 05 99 - REQUIREMENTS FOR CONTRACT COMPLETION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Following is a partial list of items that must be submitted as required before Contract Completion.
1. All Plumbing, Fire Protection, and HVAC Contractors:
    - a. Receipt for Operating Instructions and Service Manual
    - b. Certificate of Equipment Demonstration
    - c. Valve tags and charts
    - d. Receipt for keys
    - e. Warranties
    - f. All required test reports as specified in other Sections
    - g. All As-Built Drawings per Specifications
  2. Plumbing Contractor only:
    - a. Certificate of Plumbing Inspection
    - b. Certificate of Sterilization
    - c. Certification that the solder or brazing used for entire new domestic water piping system is lead-free.
    - d. Certificate from local fire department, Ohio EPA, or both that fuel storage tanks and equipment installation is acceptable.
    - e. Medical Gas Certifications
  3. Fire Protection Contractor only:
    - a. Fire Marshal's certification of inspection and acceptance
    - b. Certification from local fire department that pipe threads are suitable for their equipment.
  4. HVAC Contractor only:
    - a. Certificate of Inspection
    - b. Air and water balance reports
    - c. Contractor's Certificate of Operation of fire and smoke dampers
- B. In addition to the written submittals, the following material shall also be submitted prior to Contract Completion. Submit a signed copy of the Certificate of Materials Receipt. (ATTACHED TO THE END OF THIS SECTION)
1. Loose or spare parts as specified in other Sections.
  2. Spare parts as specified in this Section.
- C. Refer to Division 1 for additional requirements.

PART 2 PRODUCTS

2.01 SPARE PARTS

- A. Furnish one complete set of the following spare parts:
1. Gaskets for manholes and handholes
  2. Glass for each water gauge

3. All air filters (does not include air filters used during construction)
4. Special keys, wrenches, and similar required or special tools

### PART 3 EXECUTION

#### 3.01 OPERATIONAL TEST

- A. At completion, operate the systems at least five (5) days, not necessarily consecutive, to demonstrate fulfillment of the requirements of the Contract. During this time, make adjustments so that equipment will perform as the manufacturer intended and systems will function as designed. Complete balancing before operating test is started.
- B. Operate each system in every mode of operation and check the position of valves, dampers, and other devices for proper closure and switching.
- C. Following completion of the testing described previously, sign and submit the Certificate of System Completion. (ATTACHED TO THE END OF THIS SECTION)

#### 3.02 PERSONNEL INSTRUCTION

- A. After all system operational tests have been completed, schedule an instruction period with the Owner. Instruct the Owner-designated personnel in the operation and maintenance of all systems and equipment. Use manuals to familiarize the Owner-designated personnel with equipment and procedures. Allow time as necessary for this instruction. Schedule time convenient for the Owner and the Architect.
- B. The instruction is to include the following:
  1. Location of items of equipment and explanation of their use
  2. Reference to service manual for record and clarity
  3. Coordination of written and verbal instructions so that each is understood by personnel
  4. Explanation of control system
  5. Complete review of items in the manuals
  6. Maintenance procedures to be followed by the Owner
- C. At the completion of instruction, have all attendees sign the Certificate of System Completion. (ATTACHED TO THE END OF THIS SECTION)

END OF SECTION

CERTIFICATE OF MATERIAL RECEIPT

Project Name: \_\_\_\_\_

Date: \_\_\_\_\_

Contractor: \_\_\_\_\_

Contractor's Representative: \_\_\_\_\_

On the date listed previously, the following pieces of equipment, as required by the Project Specifications, were delivered to the Owner's representative:

Equipment	Quantity
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

(Attach a separate page for additional items)

Owner's Representative: \_\_\_\_\_ (PRINT)

\_\_\_\_\_ (SIGN)



CERTIFICATE OF SYSTEM COMPLETION

Project Name: \_\_\_\_\_

Contractor: \_\_\_\_\_

System: \_\_\_\_\_

Specification Section Number: \_\_\_\_\_

A. Manufacturer's Inspection and Approval (if required by specification section)

The previously identified system has been inspected and approved as meeting the manufacturer's written instructions for installation and operation.

Manufacturer's Representative: \_\_\_\_\_ Date: \_\_\_\_\_

B. Testing

The previously identified system has passed all testing required by the Project Specifications and has met the terms of the contract. Written test results are attached.

Contractor's Representative: \_\_\_\_\_ Date: \_\_\_\_\_

C. Equipment Demonstration

The previously identified system has been demonstrated to the following Owner's representatives:

Name	Title	Date	Signature
------	-------	------	-----------

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

(ATTACH A SEPARATE PAGE FOR ADDITIONAL NAMES)

SECTION 23 05 01 - HEATING, VENTILATING, AND AIR CONDITIONING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish material, labor, tools, accessories, and equipment to complete test, adjust, start up, balance, and successfully run all HVAC systems of this Project as described in these Specifications and as shown on the Drawings.
- B. Refer to Sections 20 00 00 through 20 99 99 (as included) for items of a general nature which apply to this portion of the Work. Sections 23 00 00 through 23 99 99 (as included) describe the HVAC work.
- C. It is the intent that the HVAC Work be complete in every respect.

1.02 LICENSES

- A. The installation of this HVAC work shall be made by a Contractor and craftsmen licensed by the Governing Authorities.
- B. Obtain all permits and licenses required by Local Code Authorities having jurisdiction.

1.03 FEES

- A. Unless otherwise noted, this Contractor shall pay for all permits, inspection fees, and other charges related to the installation and inspection of the HVAC work.

1.04 CODES, REGULATIONS, AND STANDARDS

- A. Unless otherwise noted, the latest enforced Edition shall apply to this work.

1.05 HVAC ROUGH-INS

- A. Provide service rough-ins and make final connections to equipment furnished by the Equipment Contractor or the Owner.
- B. Provide piping, valves, ductwork, and specialties as required, and as specified under other Sections of these Specifications.

1.06 EQUIPMENT CONNECTIONS

- A. Make final connections to equipment. Coordinate rough-in locations with other Contractors.
- B. Refer to approved equipment drawings for exact rough-in sizes and locations.

END OF SECTION

SECTION 23 05 02 - HVAC SPECIALTIES

PART 1 GENERAL

1.01 DESCRIPTION

- A. Provide all HVAC specialties required to complete the installation of all HVAC systems.
- B. Manufacturers: Refer to individual product item.

PART 2 PRODUCTS

2.01 PRESSURE/TEMPERATURE TEST PLUGS (PETE'S PLUG)

- A. 1/4 inch NPT fittings to receive either a temperature or pressure probe, 1/8 inch O.D. Fitting, and caps shall be brass with valve core of Nordel, rated at 400 psig, 45 degrees F to 275 degrees F.
- B. Manufacturers: Peterson Equipment Company, Flow Design or Sisco.

2.02 GAUGES AND THERMOMETERS

- A. Pressure gauges shall have a 4 1/2 inch dial glass face with psig calibrations,  $\pm 0.5\%$  of span accuracy, and provided with ball valve. Select pressure gauges with a full scale pressure range of approximately twice the normal operating pressure. The maximum operating pressure should not exceed 75% of the full scale range.
- B. Compound gauges shall have 4 1/2 inch dial glass face with psig and inches of mercury calibrations,  $\pm 0.5\%$  of span accuracy and provided with ball valve.
- C. Thermometers shall be industrial type, 9 inch scale, heavy-duty casing, mercury-free, non-toxic organic spirit-filled, double-strength window, adjustable angle, insertion bulb, separable socket with insulated extension and degrees Fahrenheit calibration. Provide 0-120 degrees F range for chilled water and condenser water systems; 30-240 degrees F for heating hot water systems.
- D. Provide throttling devices when a pressure gauge is measuring pressure immediately on the discharge of any pump, and in all other places where gauges may be subject to rapid pressure fluctuations. Use throttle screws, pulsation dampeners, gauge savers, pressure snubbers, instrument valves, or steel needle valves appropriate for the specific application.
- E. Provide ball valves for all pressure gauges.
- F. Manufacturers: Ashcroft, Miljoco, Terice, Marsh, Marshalltown, Weksler, or Weiss.

## 2.03 HYDRONIC SPECIALTIES AND PIPING AUXILIARIES

- A. ASME Safety Relief Valves
  1. Install bronze body ASME safety relief valves on make-up water line to protect make up water line against overpressure conditions. Relief settings shall be no greater than the boiler pressure rating. (B&G No. 790)
  2. Manufacturers: Bell & Gossett, Taco, Amtrol, or Armstrong.
- B. High Capacity Air Vents
  1. Install high capacity air vents at the highest point of the water main and at the top of the main risers.
  2. Vents shall be designed for 125 psig and 250 degrees F. (B&G No. 107A)
  3. Manufacturers: Bell & Gossett, Taco, Amtrol, or Armstrong.
- C. Automatic Air Vents
  1. Install automatic air vents at high points of branch pipes and risers, coils, and heating elements.
  2. Vent shall be designed for 125 psig and 240 degrees F. (B&G No. 87)
  3. Manufacturers: Bell & Gossett, Taco, Amtrol, Bermad, or Armstrong.
- D. "Coin Operated" Air Vents
  1. Install air vents at high points of branch pipes and risers, coils, and heating elements.
  2. Air vent shall be designed for 125 psig and 250 degrees F.
  3. Manufacturers: Bell & Gossett, Taco, Amtrol, or Armstrong.
- E. Factory Assembled Valve Hookups-2 inches and smaller
  1. All components shall be rated for 125 psig working pressure and shall be full-port (full-bore) design.
  2. The component order and arrangement shall comply with the piping diagrams shown on Drawings.
  3. The individual components of the assembly shall meet the specification requirements for components of a field-assembled system.
  4. Manufacturers: Bell & Gossett, Flow Design, Griswold, Hayes, and HCi.
- F. Wafer-type Orifices
  1. Install flow meter orifices for measuring system of flow by determining differential pressures. (B&G No. OP 2 1/2 A through OP12A)
  2. Acceptable Manufacturers: Bell & Gossett or Taco.
- G. Vacuum Breakers
  1. Install vacuum breakers to protect pressure vessels and piping systems against collapse when vacuum is induced. (B&G NO. 2.6)
  2. Acceptable Manufacturers: Bell & Gossett, Taco, Amtrol, Bermad, or Armstrong.
- H. Triple Duty Valves – Not Allowed
- I. Dielectric Unions
  1. Union shall be ground joint, bronze to bronze when connecting steel to copper pipe.
  2. Install Dielectric Unions at all pipe connections of dissimilar metal.
  3. Manufacturer: Epic or Capitol Manufacturing Company.

- J. Strainers
  - 1. Install strainers before all pumps, coils, flow meters, and control valves.
  - 2. Y-type strainers, cast bronze body with screwed ends for sizes up through 2 inches, and cast iron body with flanged ends on sizes 2 1/2 inches and larger, rated for 125 psig, with perforated stainless steel screen. Screen opening sizes: Up to 2 inches - 0.033 inch, 2 1/2 inches through 4 inches - 0.062 inch, 5 inches and up-1/8 inches. Provide blowdown valve with hose end fitting.
  - 3. Basket strainers, clamped cover, 125 lb. cast iron body with flanged connections and perforated stainless steel screen. Screen opening sizes: Up to 2 inches - 0.033 inch, 2 1/2 inches through 4 inches - 0.062 inch, 5 inches and up-1/8 inch.
  - 4. Manufacturers: Armstrong, Wheatley, Keckley, Mueller, FabroTech, or Islip.
  
- K. Flow Switches
  - 1. 300 psig and 300 degrees F, contact rating of 120-240 AC, 125 VA, close on flow and open with no flow.
  - 2. Manufacturers: McDonnell-Miller or Magnetrol.
  
- L. Make-up Water Solenoid Valves
  - 1. Normally closed solenoid valve.
  - 2. Manufacturers: ASCO or Magnetrol.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Contractor shall install specialties at locations and in an arrangement required to facilitate the maintenance, operation, and servicing of all HVAC piping systems.
- B. Clean all strainers before system start-up and balancing.
- C. Install pressure reducing stations in the locations shown on the Drawings and connect high pressure and low pressure steam mains. Install valves, traps, strainers, steam pressure gauges, and specialties as detailed on the Drawings.

END OF SECTION

## SECTION 23 05 23 - HVAC VALVES

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Provide ball valves, gate valves, and butterfly valves to facilitate maintenance and isolation of all piping systems, provide globe valves to regulate flow, and provide check valves to prevent back flow.
- B. Provide valve chart. Refer to Section 20 05 20, "Record and Information Manuals."

#### 1.02 QUALITY ASSURANCE

- A. Standards: American National Standards Institute (ANSI), American Society of Mechanical Engineers, (ASME), American Society for Testing and Materials (ASTM), and the Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
- B. Valves shall be rated at least 20% over the maximum system working pressure.
- C. All valves of the same type used on the project shall be by the same manufacturer, except as noted.

### PART 2 PRODUCTS

#### 2.01 Hvac systems with operating temperatures up to 200 degrees f. For heating hot water, chilled water, condenser water glycol solutions, heat recovery, and make-up water:

- A. Ball Valves 2 Inches and Smaller: 2-piece, 150 lb. SWP, 600 lb. WOG, cast bronze body, reinforced PTFE seals, full port, stainless ball and stem, extension shaft for insulation clearance, threaded ends.
  - 1. Acceptable Manufacturers: Milwaukee Valve, Apollo, Hammond, Powell, Watts, Nibco, or Crane.
- B. Butterfly Valves 2 1/2 Inches and Larger: 150 lb. SWP, 200 lb. WOG, full lug type, cast iron or ductile iron body, extended neck, EPDM seal, aluminum bronze or epoxy coated ductile disc, stainless steel shaft, sizes up 6 inches - lever operated with memory stop, 8 inches and larger - gear operated. Valves and seats shall be rated 150 psig shutoff during dead end service without downstream piping or flange. Provide lever with lever operated valve.
  - 1. Acceptable Manufacturers: Milwaukee Valve, Apollo, Hammond, Watts, Nibco, Keystone, Crane, or Mueller.
- C. Globe Valves 2 Inches and Smaller: 125 lb. SWP, 200 lb. WOG, cast bronze body, solid cast bronze disc, threaded bonnet, non-rising stem, handwheel operator, threaded ends.
  - 1. Acceptable Manufacturers: Milwaukee Valve, Apollo, Hammond, Powell, Watts, Nibco, or Crane.

- D. Globe Valves 2 1/2 Inches and Larger: 125 lb. SWP, 200 lb. WOG, cast iron body, solid cast bronze disc and seat ring conforming to ASTM B-62, bolted bonnet, rising stem, handwheel operator, flanged ends.
  - 1. Acceptable Manufacturers: Milwaukee Valve, Apollo, Hammond, Powell, Watts, Nibco, or Crane.
  
- E. Swing Type Check Valves 2 Inches and Smaller: 125 lb. SWP, 200 lb. WOG, cast bronze body, brass disc, threaded bonnet, threaded ends.
  - 1. Acceptable Manufacturers: Milwaukee Valve, Hammond, Powell, Watts, Nibco, or Crane.
  
- F. Swing Type Check Valves 2 1/2 Inches and Larger: 125 lb. SWP, 200 lb. WOG, cast iron or ductile iron body, cast iron or stainless steel disc, bronze seat ring, bolted bonnet, flanged ends.
  - 1. Acceptable Manufacturers: Milwaukee Valve, Hammond, Powell, Watts, Nibco, or Crane.
  
- G. Globe Body Silent Check Valve 2 1/2 Inches and Larger: 125 lb. SWP, 200 lb. WOG, cast iron or ductile iron body, bronze or stainless steel disc, bronze or welded nickel seat, stainless steel spring, flanged ends.
  - 1. Acceptable Manufacturers: Milwaukee Valve, Hammond, Watts, Nibco, Mueller, DeZurik, or Crane
  
- H. Manual Balancing Valves
  - 1. Install balancing valves with separate shut-off or service valves, where shown on the Drawings. Valves shall be designed for use as a balancing valve and flow measurement device, to facilitate adjustment of system flow rates to meet project design requirements. Provide means for connecting to a portable differential pressure meter for readout.
  - 2. Valves shall be equipped with flanged or union connections, read out ports with integral check valves, and a variable orifice or a fixed venturi for differential pressure readings. Valves shall be ball type or multi-turn globe style.
  - 3. Valves shall be designed for 125 psig and 250 degrees F.
  - 4. Acceptable Manufacturers: ITT Bell & Gossett, "Circuit Setter," Flow Design, Tour and Anderson, Griswold, Taco, Hayes, or Armstrong.
  
- I. Manual Combination Balancing and Shutoff Valves
  - 1. Install combination balancing valves with integral service shut-off valves, where shown on the Drawings. Valves shall be designed for use as a balancing valve, a flow measurement device, and an isolation valve to facilitate adjustment of system flow rates to meet project design requirements, and for positive service shutoff. Provide means for connecting to a portable differential pressure meter for readout.
  - 2. 2 Inches and Smaller: 125 psig working pressure at a maximum temperature of 250 degrees F. Provide brass or bronze body full port stainless steel ball valves with fixed venturi or variable-orifice design. Provide integral calibrated dial on valves using a variable orifice, and a memory stop on variable orifice devices.
    - a. Acceptable Manufacturers: Armstrong Series CBV, Bell & Gossett "Circuit Setter Plus," Tour and Anderson, Griswold "Quick Set," Taco, Flow Design "Accusetters," Hayes, or HCi.

3. 2 1/2 Inches and Larger: 125 psig WOG, cast iron body with brass trim valve including upstream and downstream taps, with fixed venturi or variable-orifice design. Provide integral calibrated dial on valves using a variable orifice, and a memory stop on variable orifice devices. Valves shall be ball type or multi-turn globe style.
  - a. Acceptable Manufacturers: Armstrong Series CBV, Bell & Gossett "Circuit Setter Plus," Tour and Anderson, Griswold "Quick Set," Flow Design "Accusetters," Taco, Hayes, or HCl.

### PART 3 EXECUTION

#### 3.01 INSTALLATION OF VALVES

- A. Valves shall be installed as called for in the Specifications, at locations shown on the Drawings, and as required to facilitate the maintenance, operation and servicing of all HVAC piping systems.
- B. All valves shall be line size unless noted otherwise on the Drawings.
- C. Valves shall be installed at service connections to equipment, at branch take-off lines, at mains at low points for draining, and at high points for venting.
- D. Valves shall be installed with the hand wheel at or above the centerline of the pipe.
- E. Valves installed in copper lines shall be provided with screwed or flanged adapters with a union installed downstream and within 12 inches of the valve.
- F. Valves shall be installed in accessible locations. Coordinate with ceilings, structure, mechanical and electrical equipment.
- G. Provide chain wheel and chain for all valves located with the lowest portion of its handwheel or lever at 10 feet or more above the finished floor.
- H. Boiler valves shall be installed in strict compliance with the State Pressure Piping Regulations. Install blowdown valves with hose end adapter at all strainers.
- I. Install shutoff and gate drain valves in branches and risers.
- J. Install 3/4 inch drain valves with hose end and capped in piping at low points to provide complete drainage of all systems.
- K. Install access panels for all valves above inaccessible ceilings and located in walls or chases. Coordinate panel locations with the General Contractor and Owner's Representative.

#### 3.02 PROHIBITIONS

- A. Do not install any valves where the fluid operating pressure exceeds 80% of its pressure rating.
- B. Brass valves are prohibited in all HVAC water systems.



3.03 TESTS

- A. Test all valves for tightness.
- B. Test operate all valves at least once from closed-to-open-to-closed positions while valve is under pressure. Replace or repair leaking valve.

END OF SECTION

SECTION 23 05 93 - HVAC SYSTEMS BALANCING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Provide all labor, materials, and tools for completely testing, balancing and adjusting the air and water systems.
- B. The HVAC Contractor shall retain the services of an Independent Testing, Adjusting, and Balancing (TAB) Agency that specializes in, and whose business is limited to, the testing and balancing of HVAC systems.

1.02 SUBMITTALS

- A. Strategies and Procedure Plan: Submit a step by step, test and balance procedures plan. The plan shall include equipment and systems to be tested, strategies and step by step procedures for balancing, instruments to be used and sample forms.
- B. Provide a summary report of the examination review, if any issues are discovered that may preclude the proper testing and balancing of the system.
- C. Certified Report: Within 14 days of completion of the balancing work, submit a certified test and balance report.

1.03 QUALITY ASSURANCE

- A. Agency shall be fully certified by AABC or NEBB.
- B. Standards: AABC National Standards for Total System Balance or NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.
- C. Instruments used for testing and balancing shall have been calibrated within a period of six months and checked for accuracy prior to start of work on this project.
- D. The agency shall also comply with the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) recommendations pertaining to measurements, instruments and testing, adjusting and balancing.

PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper T&B of systems and equipment. 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. Note the locations of devices that are not accessible for testing and balancing. Examine the approved submittals for HVAC systems and equipment.
- B. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, clean permanent filters are installed and controls are ready for operation. Examine terminal units and verify that they are accessible and controls are connected, configured and functioning. Examine strainers to verify that mechanical contractor has replaced start up screens with permanent screens and that all strainers have been cleaned. Examine two-way and three-way valves for proper installation and function. Examine heat transfer coils for correct piping connections and for clean and straight fins. Examine air vents to verify that mechanical contractor has removed all air from the hydronic system.

### 3.02 GENERAL PROCEDURES

- A. Air Systems: Prepare test reports for both fans and outlets. Obtain approved submittals and any manufacturer-recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes. Prepare a single-line schematic diagram of systems for the purpose of identifying HVAC components. For variable-air-volume systems, develop a plan to simulate diversity. Determine the best locations in main and branch ducts for accurate duct-airflow measurements. Locate start-stop and disconnect switches, electrical interlocks, and motor starters. Verify that motor starters are equipped with properly sized thermal protection. Check condensate drains for proper connections and functioning. Check for proper sealing of air-handling-unit components.
- B. Water Systems: Prepare test reports for pumps, and coils. Obtain approved submittals and any manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger gpm with pump design flow rate. Verify that hydronic systems are ready for testing and balancing:
  - 1. Check that makeup water has adequate pressure to highest vent.
  - 2. Check that control valves are in their proper positions.
  - 3. Check that air has been purged from the system.
  - 4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
  - 5. Verify that motor starters are equipped with properly sized thermal protection.

### 3.03 WATER SYSTEMS

- A. After all equipment and piping installation, the hydronic systems shall be balanced for proper distribution and uniform temperature drop. The flow of water shall be adjusted, using flow meters and system balancing valves. For systems with diversity, determine the diversity factor and simulate the system diversity by closing the required number of control valves. Repeat this procedure through the system. Record the final pump performance.

### 3.04 AIR SYSTEMS

- A. After all equipment and duct installation, the air systems shall be balanced for proper distribution. For systems with diversity, determine the diversity factor and simulate the system diversity by closing the required number of control dampers. Repeat this procedure through the system. Do not make fan speed adjustments that result in motor overload. Operate the system in all modes to assure the fan motors will not overload. Verify final operation of the equipment and fan. Provide a complete profile of static pressures throughout the air handling unit components.
- B. In measuring velocities in ducts or at outlets, traverse the duct or outlet so that one reading is taken for each 80 square inches maximum of flow area, but a minimum of six readings shall be taken for each duct or outlet regardless of size.
- C. Determine by field measurements the installed K-factor of each terminal box. Set correct value in the BAS and record the value in the final report.

### 3.05 TOLERANCES

- A. Flow rates shall be balanced within plus or minus 5% of design conditions. Any discrepancies exceeding this range or items not in accordance with contract documents, which may affect the total system or systems balance shall be reported to the HVAC Contractor for corrections. Balance procedures shall be repeated following corrections to confirm that corrections were made.
- B. Assist the Mechanical Contractor in the selection of additional fixed sheaves as required to achieve the proper final balance of belt drive units. Sheaves and belts shall be furnished and installed by the Mechanical Contractor.
- C. Verifications shall continue, at no cost to the Owner, until the system is in compliance with the Contract Documents.

### 3.06 FINAL TEST AND BALANCING REPORT

- A. The report shall be a complete record of the HVAC system performance, including conditions of operation, items outstanding, and any deviations found during the T&B process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the technicians or test and balance engineers. As a minimum, the report shall include the following:
  - 1. Title Page
  - 2. Table of Contents
  - 3. Performance Guarantee
  - 4. Report Summary including a list of items that do not meet tolerances with information that may be considered in resolving the deficiencies.
  - 5. Test and Balance Data
- B. Provide final copies, in accordance with the submittal requirements, of the final test and balance report to the Engineer.

END OF SECTION

SECTION 23 07 05 - HVAC INSULATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Insulate the following:
  - 1. Piping:
    - a. Heating water
    - b. Condensation drain
    - c. Refrigerant lines
  - 2. Ductwork:
    - a. Supply
    - b. Return
    - c. Outside air
    - d. Plenums
  - 3. Equipment:
    - a. Coil sections of all terminal boxes that are not factory insulated
- B. Items not requiring insulation include:
  - 1. Unions and valves in heating hot water lines
  - 2. Inverted bucket, thermodynamic, or bi-metallic steam traps, heating hot water pumps, electric condensate pumps, heating hot water expansion tanks
- C. Refer to Section 23 31 10, "Low Velocity Ductwork" for duct liner.

1.02 QUALITY ASSURANCE

- A. Indoor pipe and duct insulation shall have a flame-spread rating not exceeding 25, a smoke-developed rating not exceeding 50, and a fuel-contributed rating not exceeding 50. All insulation accessories shall have similar ratings. All rating procedures shall meet the standards set in ASTM E-84, NFPA 255, and UL 723.
- B. Install insulation to according to "Commercial and Industrial Insulation Standards," as published by the Midwest Insulation Contractor's Association, latest edition.
- C. Insulation values shall be in accordance with the State Energy Codes.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Protection: Leave insulation boxed and stored until time for use. Elevate and cover material to avoid moisture condensation and physical abuse.

1.04 MANUFACTURERS

- A. Fiberglass-based insulation: Owens-Corning, Manson, Knauf, or Johns-Manville.
- B. Closed-cell elastomeric insulations: Armacell, Rubatex, or IMCOA.

- C. Calcium silicate insulation: Pabco Super Caltemp Gold 1500, or approved equal by Kaylo.
- D. Polyisocyanurate insulation: Dow Chemical Company

PART 2 PRODUCTS

2.01 ADHESIVES, FINISHES, AND MASTICS

- A. Use the following items or equivalent items:
  1. Vapor barrier lap adhesive - Foster Drion Contact Bond Cement 85-75
  2. Lagging adhesive - Foster 81-42W
  3. Metal bonding adhesive - Foster 85-15
  4. Indoor vapor barrier finish - Foster 30-80
  5. Indoor breather finish - Foster Lagtone 46-50
  6. Outdoor vapor barrier mastic - Foster 46-50
  7. "Fuse-Seal" sticks and applicator (for polyolefin insulation)

2.02 THERMAL RESISTANCE OF PIPING INSULATION

- A. Insulate all piping installed to serve buildings and within buildings in accordance with the minimum pipe insulation as listed in the following table. Pipe insulation not required between control valve and heating coil on runouts when the control valve is within 4 feet of coil and piping is 1 inch or smaller. Condensate system design temperature shall match the saturation temperature of the steam system they drain.

Minimum Insulation Thickness for Pipe Sizes (Inches)						
Piping System Types	Fluid Temperature Ranges (°F)	Less than 1	1 to 1-1/4	1 1/2 to 3	4 to 6	8 and Over
<b>Hot water heating systems:</b>						
Heating hot water	141-200	1.5	1.5	2.0	2.0	2.0
<b>Cooling systems:</b>						
Condensate	Above 40	0.5	1.5	1.5	1.5	1.5
Refrigerant	Below 40	1.0	1.5	1.5	1.5	1.5

- B. Pipe sizes are nominal dimensions. For piping exposed to outdoor temperatures, increase thickness by 0.5 inches.

2.03 INDOOR PIPING

- A. Use fiberglass, heavy-density insulation with all service jacket and pressure sealing lap adhesive on longitudinal and butt strips. Jacket vapor membrane shall have an installed vapor permeance of not more than 0.09 perms. Staple and seal with pressure-sealing lap adhesive on longitudinal and butt strips. Insulation conductivity shall be in accordance with the following table. Condensate system insulation design temperature shall match the saturation temperature of the steam system they drain.

Piping System Types	Fluid Design Temperature Ranges (°F)	Insulation Conductivity Range (Btuh in./ft <sup>3</sup> deg. F)	Mean Rating Temperature (°F)
<b>Steam, condensate, and hot water heating systems:</b>			
Heating hot water	141-200	0.25-0.29	125
<b>Cooling systems:</b>			
Condensate	Above 40	0.21-0.27	75
Refrigerant	Below 40	0.20-0.26	50

2.04 EXPOSED INDOOR PIPING UP TO 10 FEET ABOVE NEAREST WALKING SURFACE

- A. Insulation same as for indoor piping. Cover with ultraviolet-resistant PVC jacket. Jacket is to be self-extinguishing and have zero fuel contribution. All piping visible inside and outside mechanical room is considered exposed.
  - 1. Ceel-Co Ceel-Tite 300 Series or Foster Sealfas.
- B. Insulation same as for indoor piping. Cover with 0.016 inch thick aluminum jacket with "Pittsburgh Seam." Seal between metal jacket and sleeve. All piping visible inside and outside mechanical spaces is considered as exposed.

2.05 FITTINGS AND VALVES

- A. Premolded PVC covers over molded insulation. Insulation same thickness as on adjoining pipe. Insulation shall have a flame-spread rating not exceeding twenty-five (25) and a smoke-developed rating not exceeding fifty (50). Exception: heating valves and unions, or any components specified to have removable covers.

2.06 OUTDOOR PIPING

- A. Insulation type and vapor barrier shall be the same as indoor piping. Increase insulation thickness by 1/2 inch, minimum. Cover with ultraviolet-resistant PVC jacket. Jacket is to be self-extinguishing and have zero fuel contribution.
  - 1. Ceel-Co Ceel-Tite 300 Series or Foster Sealfas.
- B. Insulation type and vapor barrier shall be the same as indoor piping. Increase insulation thickness by 1/2 inch, minimum. Cover with 0.016 inch thick aluminum jacket with "Pittsburgh Seam." Seal between metal jacket and sleeve.

2.07 PIPE INSULATING SUPPORT

- A. Refer to Section 20 05 45, "Hangers, Supports, and Inserts." The use of thermal protectors as pipe insulation support are noted elsewhere in this Specification. Maintain insulation vapor barrier integrity where inserts are used.

2.08 REFRIGERANT PIPING

- A. Insulation for all indoor refrigerant piping shall be the same as for indoor piping.
- B. Insulation requirements for all outdoor refrigerant piping shall be the same as for outdoor piping.
- C. Option: Flexible elastomeric thermal insulation  $K=0.27$  at 75 degrees F, as manufactured by Armacell, Rubatex, or IMCOA. Indoor insulation must meet a flame-spread rating not exceeding twenty-five (25) and a smoke-developed rating not exceeding fifty (50), as specified in Paragraph 1.02.A.

2.09 INSULATE DUCTWORK AS FOLLOWS

Duct Type	Minimum Insulation Thickness (Inches)	Minimum R-Value (As-installed; not including film resistance)
Concealed-round or rectangular	2	6.0
Exposed-round	1 1/2	4.5
Exposed-rectangular	1	4.3
Underground	1 1/2	5.0
Exposed-rectangular-outdoors	2	8.0
Exposed-round-outdoors	2	8.0
Outdoor air intakes	2	8.7

2.10 CONCEALED DUCTWORK - ROUND OR UNLINED RECTANGULAR

- A. Flexible fiberglass duct wrap laminated to foil-reinforced kraft vapor membrane facing with 2 inch stapling flange, 1.0 pcf density,  $K=0.27$  at 75 degrees F, Owens-Corning Commercial Grade Fiberglass Duct Wrap Type 100. Installed vapor membrane shall be less than 0.09 perms.

2.11 EXPOSED DUCTWORK - ROUND

- A. Flexible fiberglass duct wrap laminated to foil-reinforced kraft vapor membrane facing with 2 inch stapling flange, 1.0 pcf density,  $K=0.27$  at 75 degrees F, Owens-Corning Commercial Grade Fiberglass Duct Wrap Type 100. Installed vapor membrane shall be less than 0.09 perms.

2.12 EXPOSED DUCTWORK - UNLINED RECTANGULAR

- A. Rigid fiberglass industrial board with foil scrim kraft vapor membrane facing, 6.0 pcf density,  $K=0.22$  at 75 degrees F, Owens-Corning Industrial Type 705. Option: ASJ Jacket. Installed vapor membrane shall be less than 0.09 perms.



2.13 EXPOSED DUCTWORK – OUTDOOR INSULATION

- A. Insulation material shall be a flexible, closed-cell elastomeric insulation in sheet form: AP Armaflex SA sheet and roll insulation, 2 inch installed thickness. This product meets the requirements as defined in ASTM C 534, specification for preformed elastomeric cellular thermal insulation in sheet and tubular form.
- B. Materials shall have a flame spread rating of 25 or less and a smoke-developed rating of 50 or less when tested in accordance with ASTM E 84, latest revision. Sheet material with a thickness greater than 1 inch shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive, and all materials shall pass simulated end-use fire tests.
- C. Materials shall have a minimum thermal conductivity of 0.25 Btu-in./h-ft<sup>2</sup> - °F at a 75 degrees F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
- D. Materials shall have a minimum water vapor transmission of 0.05 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.
- E. The material shall be manufactured under an independent third party supervision testing program covering the properties of fire performance, thermal conductivity, and water vapor transmission.
- F. Duct insulation that is installed shall be wrapped not stretched around the duct, and shall be adhered directly to clean, oil-free surfaces with a full coverage of adhesive. All insulation shall be adhered directly to clean, oil-free surfaces.
  - 1. The duct insulation shall be constructed from the bottom up, with the top insulation sized to extend over the side insulation. This will form a watershed.
  - 2. Butt-edge seams shall be adhered using Armaflex 520 Adhesive by the compression fit method to allow for expansion/contraction. Leave a 1/2 inch-wide uncoated border at the butt-edge seams on the duct surface and the insulation surface. Overlap the insulation 1/4 inch at the butt-edges and compress the edges into place. Apply Armaflex 520 Adhesive to the butt-edges of the insulation.
  - 3. Standing metal duct seams shall be insulated with the same insulation thickness as installed on the duct surface. Seams may be covered using strips of Armaflex Sheet Insulation or half sections of tubular pipe insulation with miter-cut ends. Standing seams shall be adhered using Armaflex 520 Adhesive.
  - 4. Insulation seams shall be staggered when applying multiple layers of insulation.
  - 5. On round ductwork larger than 12 inches in diameter, the insulation shall be adhered to the duct surface on the lower one third. On ductwork greater than 24 inches in diameter, the insulation shall be completely adhered to the duct surface.
- G. Use the following duct insulation adhesives or equivalent items, as recommended by the insulation manufacturer:
  - 1. Insulation adhesive - Armaflex 520 BLV
  - 2. Insulation spray adhesive - Armaflex Low VOC Spray Contact Adhesive

2.14 EXPOSED DUCTWORK – OUTDOOR INSULATION JACKET

- A. Jacketing shall be produced from a glossy white, high impact, abrasion-resistant, UV-resistant polyvinyl chloride compound. Jacketing shall have a minimum 30 mil thickness, and have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ASTM E 84, latest revision. Ceel-Co 300 Series jacketing, or approved equal, joined with Ceel-Tite welding adhesive to result is a completely sealed and self-supporting monolithic system.
- B. Jacket material shall be a pre-fabricated, self-adhering, and sheet-type water proofing membrane. Material external surface shall be a stucco-embossed, UV-resistant aluminum, backed by a double layer of high density polyethylene reinforcement, and a rubberized asphalt adhesive. Material shall be MFM "Flex-Clad 400" or approved equal and shall be installed with heat-sealed joints and in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.01 INSTALLATION NOTES

- A. Use no damaged or water-soaked insulation.
- B. Insulate piping where concealed in walls.
- C. Make insulation continuous through sleeves and hangers, except through fire-rated walls.
- D. Leave no "raw" ends on insulation. Bevel insulation terminations, seal with insulating cement, and cover ends with glass cloth or similar to pipe insulation covering.
- E. Ensure that exposed insulation has a neat and finished appearance. Size insulation if required and leave ready for painting.
- F. Ensure that jacket has overlapping joints and is sealed with suitable adhesive. The use of staples is acceptable on heating hot water systems only, but only as an installation aid and not as a substitute for adhesive.
- G. Brush coat all staples used with a white vapor barrier mastic.
- H. Use adhesive and welded pins with washers for attaching liner and rigid board insulation to ductwork. Seal joints with a 2 inch wide application of adhesive.
- I. Provide sheet metal lips on leading and leaving air edges at liner transitions.
- J. All duct sizes shown are clear inside dimensions.
- K. Tape and seal all joints.
- L. Wrap all outside air ductwork.

- M. Duct insulation that is installed shall be wrapped not stretched around the duct. On ductwork larger than 12 inches in diameter, the insulation shall be adhered to the duct surface on the lower one third. On ductwork greater than 24 inches in diameter, the insulation shall be completely adhered to the duct surface. Butt-edge seams shall be adhered using adhesive by the compression fit method to allow for expansion/contraction. Overlap the insulation at the butt-edges and compress the edges into place. Apply adhesive to the butt-edges of the insulation.

END OF SECTION

SECTION 23 09 23 - TEMPERATURE CONTROL

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. Provide a complete "Web-based" Building Automation System (BAS) to control and monitor all equipment specified herein and indicated on the Contract Drawings. System components include, but are not limited to:
  - 1. Web access communication hardware
  - 2. Direct Digital Controllers
  - 3. BACnet MS/TP Communication Protocol throughout the secondary DDC Network (Tier 2).
  - 4. Electronic Valve and Damper Actuation
  - 5. Manufacturer Unit Mounted Controllers
  - 6. Electric Controls (Line Voltage)
  - 7. Electronic Controls (Low Voltage, non-DDC)
  - 8. All new work in this project shall be compatible with, and integrated into, the existing facility Building Automation System.
- B. All work of this Section shall be coordinated and provided by a single BAS Contractor. The BAS work shall consist of the provision of all items required to provide a complete, fully functional, and commissioned BAS performing the specified sequences of operation.
- C. The BAS shall be a complete system designed for use on Intranets and the Internet. This functionality shall extend into the equipment rooms. Primary panels located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. 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 that LAN.
- D. All points of user interface shall be on standard personal computers (PCs) that do not require the use of any special software from the BAS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser such as Internet Explorer or Netscape.
- E. Servers shall be used for providing a location for archiving system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform.
- F. The BAS shall assume control of all equipment with a manufacturer provided control package. Coordinate with equipment manufacturer for any interface requirement.

- G. At minimum, The BAS as provided shall incorporate the following integrated features, functions, and services:
1. Operator information, alarm management and control functions at any Operator's console without the need for special software from the BAS manufacturer for those consoles.
  2. Primary (LAN) information and control functions.
  3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
  4. Diagnostic monitoring and reporting of BAS functions.
  5. Offsite monitoring and management
  6. Energy management
  7. Indoor Air Quality monitoring and control

## 1.02 QUALITY ASSURANCE

- A. General
1. The BAS Contractor shall be a manufacturer authorized office and have a minimum of ten years experience with the complete installation of Building Automation Systems of similar size and technical complexity.
  2. The BAS Contractor shall employ all specialists necessary and be regularly engaged in the field of Building Automation Systems. Specialists shall be capable of performing the design and detailing and shall have a working knowledge of the HVAC systems being controlled.
  3. The BAS shall consist of the products of a manufacturer regularly engaged in the production of such systems and shall be the manufacturer's latest standard of design at the time of installation.
  4. Routine maintenance and emergency service shall be available within twenty-four (24) hours upon receipt of request.
  5. At the start of the warranty period, the BAS software shall be updated to the most recent revision.
- B. The BAS Contractor shall:
1. Have a local branch facility within a 100-mile radius of the job site supplying complete maintenance and support services. Emergency service shall be available on a twenty-four (24) hour, seven (7) day-a-week basis.
  2. Be responsible for all work fitting into place in a satisfactory and neat workmanlike manner acceptable to the Owner/Architect/Engineer.
  3. Provide software support: All application design of the computerized control and monitoring system. In addition to the language manuals, flow charts, lists, and other documentation specified, the manufacturer shall locally maintain a software test, debug, and development facility to support software additions and modifications in an off-line environment.
  4. Provide hardware support: Maintain a local maintenance support facility complete with system technicians, diagnostic and test equipment and routines, and new spare digital controllers and control components.
  5. Provide a competent and experienced Project Manager employed by the BAS Contractor and supported as necessary to provide professional management service for the project. The Project Manager shall attend scheduled Project Meetings as required and shall be empowered to make technical, scheduling, and related decisions on behalf of the BAS Contractor.

### 1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Conformance with all sections of the specification is required. Additional requirements for the equipment specified within this section are included in, but not limited to, the following sections:
  - 1. 20 05 05, "HVAC General Requirements"
  - 2. 20 05 10, "Coordination Between Trades"
  - 3. 20 05 15, "Submittals"
  - 4. 23 09 93, "Sequences of Operation"
  - 5. 23 36 05, "Terminal Boxes"
  - 6. 23 33 14, "Fire and Smoke Dampers"

### 1.04 COORDINATION

- A. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades and equipment manufacturers to ensure a fully functioning and complete BAS.
  - B. All automatic control dampers, control valves, separable sockets, flow switches, flow sensors, and other in-line pipe devices, furnished by the BAS Contractor shall be installed by the HVAC Contractor under the BAS Contractor's supervision. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the HVAC Contractor.
  - C. The demarcation of work and responsibilities between the BAS Contractor and other related trades shall be as outlined in the Responsibility Matrix herein. This matrix is not intended to relieve the HVAC Contractor of the obligation to assure the complete execution of any work for which responsibility is assigned to the BAS Contractor, when the BAS Contractor is a sub-contractor to the HVAC Contractor.
    - 1. Key:
      - BAS Building Automation System Contractor
      - P Plumbing Contractor
      - H HVAC Contractor
      - E Electrical Contractor
      - EP Power for the device controls is provided by means internal to the device. Control power is provided from the power circuit to the device, which is the responsibility of the Electrical Contractor.
- Wiring Note: Power wiring by "BAS" indicates that the BAS Contractor is responsible for extending power from a junction box or source, which has been provided by the Electrical Contractor, to a device or through a transformer to low voltage system. Transformer is to be provided by the BAS Contractor.

<b>RESPONSIBILITY MATRIX</b>						
<b>WORK</b>		<b>Provided By:</b>	<b>Furnished By:</b>	<b>Installed By:</b>	<b>Low Voltage Wiring By:</b>	<b>Power Wiring By:</b>
1.	VAV Box Controllers and Terminal Unit Controllers		BAS	H	BAS	BAS
2.	Automatic Control Dampers and Actuators		BAS	H	BAS	BAS
3.	Manual Valves	H				
4.	Automatic Valves and Actuators		BAS	H	BAS	BAS
5.	VAV Boxes	H				
6.	Computer Room A/C Unit Site-Mounted Controls		H	BAS	BAS	BAS
7.	Unit Heater Controls	BAS			BAS	EP
8.	Packaged Rooftop Unit (RTU) Space Mounted Controls		H	BAS	BAS	BAS
9.	Packaged RTU Factory-Mounted Controls	H			BAS	EP
10.	Duct Smoke Detectors		E	H		E
11.	Fire Alarm Wiring from all Detectors				E	
12.	Wiring from Smoke Detector/Fire Alarm to Control LED Devices and/or Smoke Damper Actuators				BAS	

1.05 SUBMITTALS

A. Shop Drawings

1. Equipment and systems requiring approval by authorities must comply and be approved prior to submittal. Approval shall be at the expense of the BAS Contractor. Provide a copy of all related correspondence and permits to the Owner.
2. BAS System Network Architecture - One page diagram depicting the BAS complete showing Internet and Intranet access for control and monitoring.
3. AutoCAD generated schematics, flow drawings and detailed Sequence of Operation for all equipment controlled by the BAS.
4. Graphic penetration tree showing all graphics.
5. A bill of material reference list.
6. Control Valve Schedule including a separate line for each valve and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close-off Pressure, Capacity, Valve CV, Calculated CV, Design Pressure, Actual Pressure, and Actuator Type.
7. Control Damper Schedule including a separate line for each damper and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Blade Type, Bearing Type, Seals, Duct Size, Damper Size, Mounting, and Actuator Type.

8. Schedule including a separate line for each VAV box and terminal unit indicating minimum/maximum cfm, pickup gain, box area, and bias setting.
  9. Manufacturer's catalog data describing each item of control equipment or component provided and installed for the project.
  10. Points schedule for each real point in the BAS, including: Tag, Point Type, System Name, Display Units, Node Type, Address, Terminal ID, Panel, Slot Number, Reference Drawing, and Connection point.
  11. Point-to-point wiring diagrams showing all temperature controls, start-stop arrangement for each piece of equipment, equipment interlocks, wiring terminal numbers and any special connection information required for properly controlling the mechanical and lighting equipment and monitoring the fire alarm system.
  12. Data entry forms for initial parameters. Contractor shall provide English listing of:
    - a. All analog points with columnar blanks for high and low warning limits and high and low alarm limits.
    - b. All fan systems with columnar blanks for beginning and end of occupancy periods.
    - c. Samples of proposed text for points and messages.
- B. Systems Completion Statement
1. Submit a report upon project completion stating that the system is complete, has been adjusted and is operating in accordance with the Specifications and is ready for commissioning as specified elsewhere. Any deviations from specified settings or operations necessitated during system adjustment shall be specifically noted.
- C. Operation and Maintenance Manuals
1. Submit manuals immediately following receipt of notification of contract completion.
  2. Provide three complete sets of operation and maintenance manuals in a three-ring notebook and organized by subject, by systems and by equipment with divider tabs. Provide the following information
    - a. Table of Contents
    - b. Commissioning Report
    - c. Certificate of Instruction of Owner Personnel
    - d. Hardware demonstration and system acceptance test certificate
    - e. Final copies of the shop drawings outlined in paragraph above. These final submittals shall reflect all field modifications and change orders required to complete the installation.
    - f. System Operator's manuals (hardware and software).
    - g. Archive copy of all site-specific databases and sequences.
    - h. BAS network diagrams.
    - i. Wiring termination schedules.
    - j. Interfaces to all third-party products and work by other trades.
    - k. Maintenance Instructions: Document all maintenance and repair/replacement procedures. Provide ordering number for each system component, and source of supply. Provide a list of recommended spare parts needed to minimize downtime.



3. In addition to the binders, the entire Operation and Maintenance Manual shall be furnished on Compact Disc media. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the project record drawings and data sheets. A logically organized table of contents shall provide dynamic links to view and print all project record drawings and product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents. The CD-ROM(s) shall contain adequate space for future system updates.
4. On-line Documentation: After completion of all the tests and adjustments, the contractor shall install the following information on the BAS:
  - a. All necessary Node and OWS software updates to ensure all BAS software is at the current revision.
  - b. Record Drawing files
  - c. Detailed catalog data on all installed system components with address and phone number of factory repair service.

#### 1.06 DEFINITIONS

- A. Algorithm: A logical procedure for solving a recurrent mathematical problem.
- B. Analog: A continuously varying system or value (temperature current, velocity, etc.) not having discrete levels.
- C. Application Specific Controller (ASC): A general purpose, programmable controller dedicated to a single or multiple mechanical systems with the required processing capabilities and universal input/output configuration to satisfy the specified sequence of operation.
- D. BACnet: A data communication protocol for building automation control networks created and approved by ASHRAE Standards Committee 135.
- E. Building Automation System (BAS): The total system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BAS Contractor and to be interfaced to the work of other trades.
- F. BAS Contractor: The contractor or sub-contractor providing the work of this Section. This contractor shall be the primary supplier, installer, commissioner, and ongoing control service provider for the BAS.
- G. BAS Integration: The complete functional and operational interconnection and interfacing of all BAS work elements and nodes in compliance with all applicable codes, standards, and ordinances so as to provide a single coherent BAS as required by this Section.
- H. BAS Network: The total digital, on-line, real-time, interconnected configuration of BAS digital processing units, workstations, panels, sub-panels, controllers, devices, and associated elements. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN, or the like.

- I. Binary: A two-state system where an "on" condition is represented by one discrete signal level and an "off" condition is represented by a second discrete signal level each separated by a defined dead-band. (Digital Inputs and Digital Outputs are examples.)
- J. Control Sequence: A pre-programmed arrangement of software algorithms, logical computation, target values and limits to attain defined operational control objectives.
- K. Control Wiring: Includes conduit, wire and wiring devices to install complete a control system including, but not limited to, motor control circuits, interlocks, thermostats, all wiring from panel to panel and from panel to sub-panels and components such as sensors and points required to execute the control sequence.
- L. Dead-band: A controlled range over which no change in action is supplied.
- M. Direct Digital Control (DDC): The digital algorithms and pre-defined arrangements included in the BAS software to provide direct, closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative, and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- N. Distributed Control: A system whereby all control processing is decentralized and independent of a central computer.
- O. Global Control Panel (GCP): A control panel residing on the building LAN and supervising the secondary tier control network and routing communications between them.
- P. LonWorks®: DDC Integrated Circuit with embedded LonTalk® Communication protocol developed by the Echelon Corporation.
- Q. LonMark® Interoperability Association: Standards committee consisting of independent product developers and systems integrators dedicated to determine and maintain the interoperability guidelines for the LonWorks® industry.
- R. Network: A system of distributed control units that are linked together on a communication bus. A network allows sharing of point information between all control units. Additionally, a network provides central monitoring and control of the entire system from any distributed control unit location.
- S. Node: A digitally programmable entity existing on the BAS network.
- T. Operator's Work Station (OWS): The main command terminal over the BAS. The OWS consists of a high level-processing computer with varying devices of quality and capability based on the application requirements
- U. Peripheral: Input/Output equipment that communicate with the computer and make hard copies of system outputs and magnetic files. Peripherals include monitor, printer, hard drives, disk drives, modems, etc.
- V. Protocol: A defined set of rules and standards governing the on-line exchange of data between BAS network nodes.

- W. Router: A device which routes messages destined for a node on another segment sub-net or domain of the control network. The device controls message traffic and shall also serve as communication links between power line, twisted pair and RF media.
- X. Software: All programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BAS industry for real-time, on-line, integrated BAS configurations.
- Y. Tier 1: The level of the BAS Network communicating via the facility LAN between GCP's, GCP's and OWS's and any device and server.
- Z. Tier 2: The level of the BAS network communicating via the BAS Network from the GCP to the ASC's or controlled devices.
- AA. The following abbreviations and acronyms may be used in describing the work of this Division:
- |         |   |   |
|---------|---|---|
| AI      | - | Analog Input  |
| AO      | - | Analog Output                                       |
| BAS     | - | Building Automation System                          |
| CFM     | - | Cubic Feet Per Minute                               |
| DI      | - | (Binary) Digital Input                              |
| DO      | - | (Binary) Digital Output                             |
| EEPROM- | - | Electrically Erasable Programmable Read Only Memory |
| FAS     | - | Fire Alarm Detection and Annunciation System        |
| GUI     | - | Graphical User Interface                            |
| HOA     | - | Hand-Off-Auto                                       |
| I/O     | - | Input/Output  |
| LAN     | - | Local Area Network                                  |
| LED     | - | Light Emitting Diode                                |
| NC      | - | Normally Closed                                     |
| NIC     | - | Not In Contract                                     |
| NO      | - | Normally Open                                       |
| OWS     | - | Operator's Workstation                              |
| RF      | - | Radio Frequency                                     |
| RH      | - | Relative Humidity                                   |
| RTD     | - | Resistance Temperature Detector                     |
| TCP/IP  | - | Transmission Control Protocol/Internet Protocol     |
| UPS     | - | Uninterruptible Power Supply                        |
| VAC     | - | Volts, Alternating Current                          |
| VAV     | - | Variable Air Volume                                 |
| VDC     | - | Volts, Direct Current                               |
| WAN     | - | Wide Area Network                                   |

## 1.07 WARRANTY

- A. The BAS shall be free from defects in workmanship and material under normal use and service for a period of two years from the date of substantial completion. If within that time, any defect is found in operation, workmanship, or materials the defect shall be replaced, repaired, or adjusted (at the option of the BAS Contractor) at the Contractor's expense. Service shall be provided within twenty-four (24) hours upon notice from the Owner.
- B. The warranty shall extend to material that is supplied and installed by the BAS Contractor.
- C. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks. At the end of the warranty period, the Contractor shall prepare three duplicate copies of all control software on non-volatile magnetic media. Two copies, complete with hardware and software interfaces and full down-line reloading instructions, shall then be turned over to the Owner.
- D. Maintain an on-site record of all work done, all items removed from site, all items returned to the site, all new replacement items installed and all remedial programming, database entry work and recalibration undertaken including software revisions installed as a result of Warranty service.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable Manufacturers
  - 1. Automated Logic Corporation by Emcor.
  - 2. No bid alternatives.

### 2.02 BAS ARCHITECTURE

- A. Description
  - 1. The BAS shall be designed for use on intranets and internets. All networking technology used at the building communication or Tier 1 level shall be industry standard technology fully compatible with Owner provided networks in the facility. The communication protocol at the Tier 1 level shall be BACnet TCP/IP.
  - 2. The user interface will be complete, providing complete tool sets, operational features, multi- panel displays, and other display features. Systems which merely provide HTML based web pages as the operator interface will not be acceptable.
  - 3. The components on the primary tier of the network architecture system shall be the Operator's Workstation, Global Control Panels and Servers. All will use the same user interface and provide the same level of accessibility via the network.
  - 4. Provide licenses for all software in the BAS and transfer these to the Owner prior to completion.

B. General

1. The BAS shall consist of nodes and associated equipment connected by industry standard network practices. All communication between nodes shall be by digital means.
2. At minimum, the BAS network shall include the following:
  - a. Operator Workstations – fixed or portable.
  - b. Network processing, data storage and communication equipment including file servers.
  - c. Active processing nodes including field panels.
  - d. Intelligent and addressable elements and end devices.

C. Network

1. The BAS shall incorporate a primary Tier 1 network. At the Contractor's option, the BAS may also incorporate an integrated secondary Tier 2.
2. The BAS Network shall utilize an open architecture capable of all of the following:
  - a. Utilizing standard Ethernet communications and operating at a minimum speed of 10/100 Mb/sec
  - b. Connecting via BACnet Protocol at the Tier 1 level in accordance with ANSI/ASHRAE Standard 135-2001.
  - c. Connecting via LonTalk as per ANSI/EIA 709 (LonWorks) to LonMark FTT-10 transceivers at the Tier 1 level in accordance with ANSI/ASHRAE Standard 135-2001.
  - d. Connecting via BACnet Protocol in accordance with ANSI/ASHRAE Standard 135-2001 or LonTalk as per ANSI/EIA 709 (LonWorks) to LonMark FTT-10 transceivers at the Tier 2 level.
3. The BAS network shall support the LAN cabling system within the building.
4. The BAS shall include necessary components to accept and integrate controllers by alternate vendors or be integrated by an alternate vendor. The communication protocols described herein are required to meet this intent, both within this project and in future alterations and by both the BAS and the future components.

D. Third-Party Interfaces

1. BAS Contractor shall integrate real-time data from systems supplied by other trades as required herein.
2. The BAS system shall include necessary hardware equipment and software to allow data communications between the BAS system and systems supplied by other trades.
3. The trade contractor supplying other systems will provide their necessary hardware and software and cooperate with the BAS contractor in a timely manner at their cost to ensure complete data integration.

E. Power Fail/Auto Restart

1. Provide for the automatic orderly and predefined shutdown and automatic orderly and predefined startup of the BAS following loss of power. Archive and annunciate time and details of restoration.
2. Provide for the orderly, predefined, and controlled return to normal operation of controlled equipment as a result of the auto restart process.
3. Maintain the BAS real-time clock operation during periods of power outage for a minimum of 72 hours.

- F. Downloading and Uploading
    - 1. Provide the capability to generate software-based sequences, database items and associated operational definition information and user-required revisions at any OWS and the means to download same to the associated controller.
    - 2. Application software tool used for the generation of sequences shall be resident in both the node and the server.
    - 3. Provide the capability to upload operating software information, database items, sequences, and alarms to the designated server(s).
  - G. Uninterruptible Power Supply (UPS)
    - 1. Provide a UPS for supporting operator PCs and servers.
    - 2. UPS shall be sized for 50% spare capacity. The UPS shall be complete with batteries, external bypass, and line conditioning.
- 2.03 WEB SERVER
- A. The BAS contractor shall provide server(s) dedicated to the BAS that will provide archive locations for all historical data such as trends, alarm and event histories, and transaction logs. Equip servers with the same tool set that is located in the Global Control Panels for the system configuration, logic definition and graphic configuration.
  - B. Access to all information on the server will be through the same user interface used to access individual nodes. When logged onto a server the operator will be able to also interact with any of the Global Control Panels in the facility.
  - C. The server shall be in the form of supervisory level controllers with integral server or a dedicated PC server separate from the OWS. If more than four supervisory level controllers with integral servers are required to meet the project requirements the temperature controls contractor shall supply a dedicated server for the BAS.
- 2.04 USER INTERFACE
- A. General
    - 1. Any computer connected to the Owner's LAN can be designated a user interface point. The user interface shall be color graphic based with text and animation.
    - 2. User access shall be protected by an Owner defined, software-based password access protection. Password protection shall be multi-level with unique access privileges to accommodate the access requirements of different users. Provide the means to on-line manage password access control.
    - 3. The user interface shall be able to combine data from any and all of the system components in a single browser window.
    - 4. The menu driven Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
      - a. User access for selective information retrieval and control command execution
      - b. Monitoring and reporting
      - c. Alarm, non-normal, and return to normal condition annunciation
      - d. Selective operator override and other control actions
      - e. Information archiving, manipulation, formatting, display and reporting
      - f. BAS internal performance supervision and diagnostics
      - g. On-line access to user HELP menus

- h. On-line access to current BAS as-built records and documentation
  - i. Controlled re-programming, re-configuration of BAS operation and for the manipulation of BAS database information.
  - j. Create, delete, or modify control strategies.
  - k. Add control loops to the system.
  - l. Add/delete points to the system.
  - m. Assign sensors and/or actuators to a control strategy.
  - n. Tune control loops through the adjustment of control loop parameters.
  - o. Enable or disable control strategies.
  - p. Enable internet access for remote monitoring and control.
5. Provide reports and displays using simple English language descriptions and readily understood acronyms, abbreviations, and the like. All text naming conventions shall be consistent in their use and application throughout the BAS.
- B. Navigation Trees: The system will have the capability to display multiple navigation trees. At minimum, provide a tree that identifies all systems on the networks. Provide the ability for the operator to add custom trees.
- C. Alarms
1. The BAS shall be capable of routing specific alarms from specific points to specific computers and servers. Alarm management shall include:
    - a. Log date and time of alarm occurrence.
    - b. Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.
    - c. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
    - d. An audit trail for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
    - e. Direct alarms to an e-mail address or alpha-numeric pager. This must be provided in addition to the pop-up window described above
    - f. Any attribute of any object in the system may be designated to report an alarm.
    - g. Alarm lockout software shall be provided to prevent nuisance alarms. On initial start-up of other mechanical equipment, a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Lockout period is to be programmable on a per point basis from 0 to 90 minutes in one minute increments.
- D. Reports: BAS shall be capable of having user defined reports generated and directed to any or all, at the user's option, user interface displays, printers, or archive.
- E. Graphical User Interface via Dynamic Color Graphics
1. An unlimited number of graphic displays shall be able to be generated and executed.
  2. Values of real time attributes displayed on the graphics shall be dynamic and updated on the displays.
  3. The graphic displays shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
  4. The user shall be able to change values (setpoints) and states in system controlled equipment directly from the graphic display.

5. Provide a graphic editing tool that allows for the creation and editing of graphic files. It shall be possible to edit the graphics directly while they are online, or at an off line location for later downloading. The graphics editor shall allow zones of the building, mechanical systems, floor plans, etc., to be custom generated for the project.
6. System shall be provided with a complete user expandable, industry standard, symbol library for graphic generation containing all of the basic symbols used to represent components of a typical BAS system.
7. Provide a DLL Software driver to dynamically map LonTalk® SNVT's into the Window based graphics application.

F. Scheduling

1. Provide scheduling capability that will initiate events for execution at a specific day, time or upon the occurrence of an event. Program features include:
  - a. Analog points commanded to a specific value.
  - b. Digital points commanded to a specific state.
  - c. Manual initiation via operator's command.
  - d. Commands must honor sequence commanded delays.
  - e. Commands must honor commanded and residual priority structures allowing higher priority commands to override lower priority commands and residual priority.
2. The system shall provide multiple schedule input forms for automatic time-of-day scheduling and override scheduling of operations. The following types shall be accommodated:
  - a. Weekly schedules.
  - b. Temporary override schedules.
  - c. Special "Only Active If Today Is A Holiday" schedules.
  - d. Monthly schedules for a twelve (12) month period.
3. Schedules shall be provided for each system or sub-system in the BAS. Each schedule shall include all commandable points residing within the system. Each point may have a unique schedule of operation relative to the schedule, allowing for sequential starting and control of equipment within the system.

G. Historical Trending and Data Collection

1. Trend and store point history data for all points and values as selected by the user on system hard drives.
2. The trend data shall be stored in a manner that allows custom queries and reports using industry-standard software tools.
3. Provide the capability to perform statistical functions on the historical database:
4. Trended data shall be capable of automatic retrieval as a data file in the most current version of Microsoft Excel.
5. The software shall allow analog and digital values and calculated results to be graphically plotted in real-time or historical format.
6. Provide a supervisory program to permit the operator to archive trended data when the memory capacity begins to reach the installed limits.

H. Paging:

1. Provide the means of automatic alphanumeric paging of personnel for user-defined BAS events.
  - a. System shall support both numeric and alpha-numeric pagers, using Alphanumeric, PET, or IXO Protocol at the Owner's option.



- b. Users shall have the ability to modify through the system software the phone number or message to be displayed on the pager.
- c. System shall utilize pager schedules to send pages to the personnel that are "on-call."
- d. BAS Contractor shall be responsible for providing a modem for connection to the paging service.

I. HVAC Application Software

1. Event Messaging: Provide for the automatic execution of user-defined messages on the occurrence of predefined real-time events.
2. Optimum Start: Provide software to start equipment on a sliding schedule based upon indoor and outdoor conditions, to determine the minimum time of HVAC system operation needed to satisfy the space environmental requirements. The optimum start/stop program shall operate in conjunction with, and be coordinated with, the scheduled start/stop and night setback programs.
3. Auto Alarm Lockout: Provide for scheduled and automatic lockout of alarm annunciation from equipment during non-normal operating conditions including shutdown, emergency power operation, fire alarm, and the like.
4. Energy monitoring: Provide software to monitor and totalize consumption as measured by pulse meters.
5. Event Initiated Programs and custom logic: Provide software to define custom logic sequences that will reside in the nodes.
6. System Restart.
7. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
8. Runtime Totalization for binary input and output points.
9. Analog/Pulse Totalization for user-selected analog and binary pulse input-type points.

2.05 GLOBAL CONTROL PANEL (GCP)

A. General Requirements

1. The GCP shall monitor all system variables including real hardware points, software variables, and controller parameters such as setpoints. The GCP shall be solid state devices equipped with only non-volatile memory (flash or EEPROM). GCP shall be programmable and governed by the requirements of their applicable codes, approvals, and regulations. The GCP shall be designed, packaged, installed, programmed, and commissioned in consideration of their specific service and prevailing operating conditions. Components shall be standard, proven products of their original manufacturer and not a custom product for this Project.
2. The GCP residing on the Tier 1 network shall be equipped with all software necessary. The operating system of the GCP shall support multi-user access.

3. The GCP shall manage and direct all information traffic on the Tier 1 network, between the Tier 1 and Tier 2 networks and to servers. Communication between GCP and OWS shall be peer-to-peer via 10/100 Ethernet using the BACnet TCP/IP protocol. The GCP shall be capable of direct connection to multiple field busses using different protocols simultaneously. The GCP will integrate data from multiple field busses. Data from all field busses will appear in common displays throughout the user interface in exactly the same format.
4. GCP shall comply with FCC Part 15 Subpart J Class A emission requirements.
5. A failure shall not cause failures or non-normal operation at any other system node other than the possible loss of active real-time information from the failed node. The node shall continue complete operation, including all safeties, in the event the local operating network communications is lost.
6. Provide Controllers with diagnostic indicators for transmit, receive, power up test, power up fail, power up test okay and bus error.
7. The GCP shall be equipped with a clock battery. The battery shall be capable of maintaining time of day, day of week, date, month, and year, independent of system power for a two week period.

B. Miscellaneous:

1. GCP shall be equipped with power supply, input/output modules, termination blocks, network transceivers, On/Off switch with over-current and transient power protection.
2. If the graphic user interface software resides in the GCP (i.e., the GCP is the network server), each GCP shall be equipped with the necessary un-interruptible power such that it will not cease operation during minor power outages, including those that occur upon transfer to emergency generator or other local power source not provided by the utility.
3. Ancillary equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity at the point of design.
4. The complete GCP including accessory devices such as power supplies, interfaces, etc., shall be mounted, wired, and housed in a NEMA 1 enclosure for plenum location or as required by the local code requirements.

## 2.06 APPLICATION SPECIFIC CONTROLLERS

A. General Requirements

1. The Application Specific Controller (ASC) shall provide both standalone and networked direct digital control of HVAC systems. Each HVAC node shall retain program, control algorithms, and setpoint information in non-volatile memory (EEPROM or Flash) in the event of a power failure, and shall return to normal operation upon restoration of power. The controller shall continue complete operation, including all safeties, in the event the local operating network communications is lost. Application Specific Controllers utilizing BACnet protocol on the Tier 2 level are acceptable.
2. A dedicated ASC shall be configured and provided for each primary HVAC system (air handler, chiller, boiler) and each terminal HVAC system (VAV box, unit heater, fan coil unit, cabinet heater, heat pump, fan powered box, CV box). Provide means of indication of system performance and setpoints at or adjacent to the ASC. Provide a means to adjust setpoints and start/stop equipment controlled by the ASC. Provide a means to prevent unauthorized personnel from accessing setpoint adjustments and equipment control functions.

3. Each ASC shall report its communication status to the GCP. The GCP shall provide a system advisory upon communication failure and restoration. The ASC shall provide the ability to download and upload configuration data, both locally at the node and via the BAS communications network using protocol as specified herein.
  4. The ASC shall be provided with a permanently-mounted local graphic terminal where required in the sequences of this specification. The local graphic terminal shall provide dynamic graphical representation of the associated system status, with the ability for the operator to enter commands with proper password protection.
  5. Provide Controllers with diagnostic indicators for transmit, receive, power up test, power up fail, power up test okay and bus error.
  6. The ASC shall be equipped with a clock battery. The battery shall be capable of maintaining time of day, day of week, date, month, and year, independent of system power for a two week period.
- B. Miscellaneous:
1. ASC shall be equipped with power supply, input/output modules, termination blocks, network transceivers, On/Off switch with over-current and transient power protection.
  2. Ancillary equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity at the point of design.
  3. The complete ASC including accessory devices such as power supplies, interfaces, etc., shall be mounted, wired and housed in a NEMA 1 enclosure for plenum location or as required by the local code requirements.
- C. Input/Output Requirements
1. The Input/Output (I/O) module back panel shall be designed to accept inputs or outputs in any combination and be modified to accept phased additions or changes to the panel point configuration. The I/O capacity shall meet the requirements of the specification plus 20% reserve capacity at the point of installation. The reserve capacity shall be in the form of additional I/O spaces in the panel. Actual modules are not necessary. If the modules/back panels are not universal, the 20% rule shall be applied to each module type.
  2. All Inputs shall be Universal type capable of handling current, voltage, resistance, or open and closed contacts in any mix. Analog current (4-20 mA and 0-100 mA) and voltage inputs (0-1 volt, 0-5 volt, 0-10 volt, and 2-10 volt) shall be supported.
  3. Each digital output module shall be equipped with 3 position override switch (auto-off-on) for manual operation. Analog output modules shall be equipped with a 2 position override switch (manual-auto) and a built-in potentiometer.
  4. Thermistor type temperature sensors shall have a programmable calibration constant unique to a specific resistance group.
  5. Normally open contacts (24 volts and 120 volts), normally closed contacts (24 volts and 120 volts), current/no current and voltage/no voltage type digital inputs shall be supported by the ASC.

6. The ASC shall accommodate both digital and analog outputs. Voltage (0-12 volts) and current (4-20 mA) outputs shall be accommodated. All analog outputs shall be proportional current or voltage type with a minimum incremental resolution of 0.5% of the full operating range of the actuating device (not 0.5% of 0-12 volts output). Match the proportional range of the output to the full operating range of the actuating device. Use zero and maximum output voltage or current values for shutdown and close-off modes. For troubleshooting and load analysis, the value of each analog output shall be available in the database for trending and display.
7. Digital outputs shall be capable of handling maintained as well as pulsed output for momentary or magnetic latching circuits. It shall be possible to configure outputs for 3-mode control (fast-slow-off) and 2-mode control.

D. ASC Software

1. Point Processing Software shall:
  - a. Update values at a maximum of one second intervals.
  - b. Retain in memory the maximum and minimum values sensed for each analog input.
  - c. Discard analog inputs based on reasonability check against previous values.
  - d. Assign engineering units and status condition identifiers to all points.
  - e. Assign priority to commands.
  - f. Execute commands based on highest priority first.
  - g. Maintain last user record to identify which command is in control.
2. Control Loops: Provide standards and custom programs to perform the specified sequence of operation. Control loops shall include Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and Adaptive Control (self-learning). The execution interval of each loop shall be adjustable from 2 to 120 seconds in one second increments.

2.07 ELECTRICAL CONTROL POWER AND LOW VOLTAGE WIRING

A. BAS Wiring

1. All conduit, wiring, accessories, and wiring connections required for the installation of the BAS shall be provided by the BAS Contractor unless specifically shown on the Electrical Drawings. All wiring shall comply with the requirements of applicable portions of the requirements for Electrical Work contained in these Specifications, and all local and national electric codes, unless specified otherwise in this section.
2. The sizing type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor.

B. DDC System Network Communication Requirements

1. At minimum, network communication shall be via Category 5 twisted pair in a plenum approved raceway or insulation.

- C. Power and Communication Wiring Transient Protection
  1. Submit catalog data sheets providing evidence that all products offered by the manufacturer are tested and comply with the standard for Transient Surge withstand capabilities for electrical devices ANSI C62.41, IEEE-587-1980, Categories A and B. Such testing shall have included power and communication trunk wiring. Compliance with IEEE-587 shall imply conformance with IEEE-472 transient standards based on the stated position of ANSI and IEEE regarding applicability of the rated standards.
  2. Communications trunk wiring shall be protected with a transient surge protection device providing the minimal protection specifications of the General semiconductor, Model #422E device.
  3. The communications circuitry, input/output circuitry, and nodes shall provide protection against a 1,000 volt, 3 amp transient signal, directly applied to the communication or input/output terminations. The manufacturer's catalog data sheet shall provide evidence of conformance with this requirement. Systems not complying with this requirement shall provide equivalent protection external to the node. Protection shall be provided for the individual communications and input/output terminations for each node. Submittal documentation shall clearly define how this requirement will be met and how the external protection will not affect the performance of the controllers.
  
- D. Input/Output Control Wiring
  1. RTD wiring shall be three-wire or two-wire twisted, shielded, minimum number 22 gauge.
  2. Other analog inputs shall be a minimum of number 22 gauge, twisted, shielded.
  3. Binary control function wiring shall be a minimum of number 18 gauge.
  4. Analog output control functions shall be a minimum of number 22 gauge, twisted, shielded.
  5. Binary input wiring shall be a minimum of number 22 gauge.
  6. Thermistors shall be equipped with the manufacturer's calibrated lead wiring.
  7. 120 volt control wiring shall be #14 THHN in 3/4 inch conduit. Provide four (4) or 20% fill extra wire in each conduit.
  8. Low voltage lighting control wiring shall be a minimum of number 22 gauge, twisted, shielded pair in a plenum approved raceway or insulation.
  
- E. Splices
  1. Splices in shielded cables shall consist of terminations and the use of shielded cable couplers which maintain the integrity of the shielding. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties as specified herein.
  
- F. Conduit and Fittings
  1. Conduit for Control Wiring, Control Cable, and Transmission Cable: Electrical metallic tubing (EMT) with compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections.
  2. Outlet Boxes (Dry Location): Shereadized or galvanized drawn steel suited to each application, in general, four inches square or octagon with suitable raised cover.
  3. Outlet Boxes (Exposed to Weather): Threaded hub cast aluminum or iron boxes with gasket device plate.

4. Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by National Electrical Codes. Enclosure type shall be suited to location.
5. Exposed conduit in kitchen locations shall be chrome plated and meet the requirements for Electrical Work contained in these Specifications.

G. Relays

1. Relays other than those associated with digital output cards shall be general purpose, enclosed plug-in type and protected by a heat and shock resistant dust cover. Number of contacts and operational function shall be as required.

2.08 FIELD DEVICES

A. Dampers (Multiple Blade Dampers)

1. Automatic dampers shall be single or multiple blade. All dampers are to be sized to the application by the BAS Contractor using methods similar to control valve sizing.
2. Frames shall be 16 gauge galvanized steel structural channel and shall have flanges for duct mounting as appropriate.
3. Blades shall be 14 gauge galvanized steel, roll-formed air foil type not exceeding 8 inches wide.
4. Damper bearings shall be permanently lubricated, stainless steel type. Dampers hung with blades mounted vertically shall be provided with thrust bearings.
5. Each blade and top and bottom of frame shall have replaceable butyl rubber seals suitable for -80 to 300 degrees F. Seals shall be mechanically locked into blade slots.
6. Jamb seals shall be flexible metal compression type.
7. Maximum damper leakage shall be 8.0 cfm/sf at 4 inch static pressure
8. Damper sections shall not exceed 16 sq. ft. and shall have minimum of one operator per damper section.
9. All dampers in modulating applications shall have opposed blades. Dampers in two position services shall have parallel blades.
10. Submittals shall include damper sizes and leakage characteristics.
11. Return air dampers shall be smoke rated dampers.

B. Valves

1. General:
  - a. The final sizing and selection of the control valves are the Contractor's responsibility. All valves are to be sized by the Control Contractor who shall submit pressure drop calculations, control valve schedule, and guarantee sufficient size and character to meet the requirements of the equipment being served.
  - b. Provide valve, actuator, and required linkages for consistent operation throughout entire valve travel.
  - c. Valves:
    - 1) Valves 4 inches and smaller shall be throttling plug type. At the Contractor's option and subject to review, a properly sized and characterized ball valve may be used for hydronic systems.
    - 2) Valves larger than 4 inches shall be throttling or rotary plug type. At the Contractor's option and subject to review, a properly sized and characterized butterfly valve may be used for hydronic systems.

2. Two-Way Hydronic Valves: The control valve shall be sized and selected with the valve fully open or as open as possible using standard valve sizes and available valve trims. The control valve shall be sized and selected based on pressure drop while fully open being approximately equal to or slightly greater than that of the controlled device (1.0 to 1.5 times). Pressure drop through valve shall not be less than 5 feet. Standard valve sizes may result in a valve that provides a little more than the indicated design flow when fully open. All available trim options and arrangements shall be considered in final valve sizing.
3. Three-Way Hydronic Valves shall be of the three port mixing type designed expressly for mixing of two inlets and providing a common outlet. The use of reverse piped diverting valves will not be acceptable. The BAS Contractor will be responsible to the HVAC Contractor relative to notification as to correct method of piping of all three-way valves. Pressure drop thru valve shall not exceed 7 feet for modulating control, and two-position control valves shall be line sized.

C. Electronic Actuators

1. General

- a. Actuators shall be sized sufficiently to operate the controlled device throughout its range of movement and provide adequate power to closed the controlled device against system differential pressures. Actuator shall be sized for 150% of required duty. Actuators may be mechanically and electrically paralleled on the same shaft to multiply the available torque.
- b. Actuators shall accept 24 VAC or VDC power supply and be UL listed, direct coupled type capable of being direct mounted over the shaft of the controlled device. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of each actuator shall be wired back to a terminal strip in the control panel.
- c. Power consumption shall not exceed 8 watts or 15 VA of transformer sizing capacity per high torque actuator nor 2 watts or 4 VA for VAV actuators. Sound level shall not exceed 45 dB for high torque nor 35 dB for VAV actuators.
- d. Electronic overload protection shall protect actuator from damage. If device jams, the actuator shall not burn out. Internal end switch type actuators are not acceptable.
- e. A reversing switch shall be provided to change action from direct to reverse in relation to control signal as operation requires. Actuator shall also have manual override, field selectable rotational/spring return direction, field adjustable zero and span. Actuator (except for Generator intake/exhaust) shall cycle in ninety (90) seconds maximum end to end full stroke, fifteen (15) seconds maximum return to normal for spring return.

2. Electronic Damper Actuators

- a. Damper sections shall be sized and coordinated based on actuator and dampers manufacturer's recommendations based on face velocity, differential pressure and damper type.
- b. All damper actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. Actuators for terminal units shall fail to last known value.

- c. Damper actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
  - d. Provide auxiliary adjustable end switches on damper shaft or blade switch to prove damper position as required by the sequence of operations.
3. Electronic Valve Actuators
- a. All actuators shall fail in the last position unless specified otherwise (as normally open/closed) in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves.
  - b. All direct shaft mount rotational actuators shall have adjustable stops to limit the travel in either direction.
  - c. Isolation valves as specified in the sequence of operations shall be furnished with adjustable end switches to indicate open/closed position.
- D. Temperature Sensors, Nodes and Transmitters
1. General Requirements
- a. Provide sensors, nodes, and transmitters as required by the sequence of operation.
  - b. Temperature transmitters shall be equipped with non-interactive, individual zero and span adjustments for calibration without iterative operations.
  - c. Each temperature sensor shall match the requirements of the associated temperature controller. Each sensor shall be designed for the appropriate application (i.e., duct, immersion, etc.) and be provided with all necessary installation accessories. Ranges shall be selected to the middle of the control range. The BAS shall be equipped with a self-calibrating feature for temperature sensors.
  - d. Temperature transmitters shall be sized and constructed to be compatible with the medium monitored. Transmitters shall be equipped with a linearization circuit to compensate for non-linearities of the sensor and bridge and provide a true linear output signal.
  - e. Temperature sensors shall be resistance type and shall be three-wire 100 ohm platinum RTD, or two-wire 1,000 ohm platinum RTD, wound nickel or thermistor type.
  - f. Thermistors shall have a minimum of 100 ohm/degrees F resistance change versus temperature. Thermistors shall be certified to be stable + 0.24 degrees F over five (5) years and + 0.36 degrees F accurate and free from drift for five (5) years. Thermistors are acceptable provided BAS can compensate for the mathematical variation of the fitting constraints and that accuracy can be obtained.
  - g. The following accuracy's are required and include errors associated with the sensor, lead wire and A to D conversion.

<u>Point Type</u>	<u>Accuracy</u>
Temperature	1.00°F
Duct Temperature	1.00°F
Water Temperature	1.00°F



2. Room Sensors and Nodes
  - a. Room temperature sensors are to be provided with a screw cover.
  - b. Terminal unit temperature sensors shall be RTD 1,000 Ohm Platinum, 2 wire, accurate to + 0.5 degrees F at room temperature with 12 Bit A to D resolution. Provide sensor without room temperature indicator and with setpoint adjustment. Adjustment shall be +/- 3 degrees from setpoint in the BAS.
  - c. Sensor shall be supplied with a vertical base for mounting on a standard single gang junction box.
3. Thermowells
  - a. All liquid temperature sensors shall be installed on thermowells. The sensor and well shall be supplied as a complete assembly including well head and Greenfield fitting. No strap-on sensors are allowed.
  - b. Thermowells shall be pressure rated and constructed in compliance with the system working pressure.
  - c. Thermowells and sensors shall be mounted in a thread-o-let or 1/2 inch NPT saddle and allow easy access to the sensor for repair or replacement.
4. Outside Air Sensors
  - a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
  - b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate surrounding the sensor element.
  - c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
5. Duct Type Sensors
  - a. Duct mount sensors shall mount in a hand box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement. A neoprene grommet (Sealtite fitting and mounting plate) shall be used on the sensor assembly to prevent air leaks.
  - b. Duct sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate. Duct sensor probe shall be constructed of 304 stainless steel.
  - c. Where a device is used for sensing of mixed air temperature and the duct or air handler cross-sectional area is in excess of 14 square feet, the instrument will incorporate an averaging element with a minimum length of 96 inches or a suitable array of duct sensors wired as a single input. Provide capillary supports at the sides of the duct unit to support the sensing string.
  - d. For outdoor air duct applications, use a weatherproof mounting box with weatherproof cover and gasket.
- E. Relative Humidity Sensors/Transmitter
  1. The relative humidity sensor shall be solid state, resistance type sensor of the Bulk Polymer Design, Class 2. The sensor element shall be washable and shall resist surface contaminations.
  2. Transmitter shall be equipped with non-interactive span and zero adjustments, a 2 wire isolated loop powered, 0-10vDC, 4-20ma, linear proportional output.
  3. The humidity transmitter shall be accurate to  $\pm 2\%$  RH, including lead loss and A to D conversion. Range shall be 20% to 80%.
  4. Acceptable Manufacturers: HyCal, General Eastern or Mamac.

- F. Humidistats shall have SPST switching which makes on a fall in relative humidity. The sensing element shall be moisture sensitive nylon ribbon wound around three bobbins to give four element control. Provide removable setting knob to prevent tampering.
- G. High Limit Humidity Controller: Duct mounted air sampling tube with nylon element for sampling humidity within the duct. Setpoint range 65% to 95% RH in 5% increments. Operable up to 125 degrees F.
- H. Pressure Sensing Devices
  - 1. General Requirements:
    - a. Sensing elements shall be corrosion resistant, bourdon tubes, bellows, or diaphragm type.
    - b. Units shall have tamper-proof adjustable range and pressure settings and shall provide an output signal of 0 to 10V dc, or 4 to 20 mA.
    - c. The sensing range and mounting of the device shall be as appropriate for the application and system design.
    - d. Pressure devices shall be constructed to withstand a minimum of 100% over pressure without damage and to hold accuracy during a momentary 40% over-range input.
    - e. Mount the sensing element within 20 feet of the pick up point. Locate transmitters in accessible location and in control panels wherever possible.
    - f. Devices shall be furnished by the BAS contractor and mounted in the duct or pipe by the HVAC Contractor.
    - g. Provide a minimum of a NEMA 1 construction for the transmitter.
    - h. Acceptable Manufacturers: Mercoid, Dwyer, or McDonnell Miller.
  - 2. Differential Pressure Switches
    - a. Switch contacts shall be snap action micro-switch type Form C contact.
    - b. Assembly shall operate automatically and reset automatically when conditions return to normal. Complete sensor assembly shall be protected against vibration and movement.
    - c. High pressure switches shall be manual reset devices.
    - d. Switches shall be vented to withstand a 50% over-pressure without loss of calibration.
  - 3. Differential Pressure Transmitters used for flow measurement shall be sized to the flow sensing device and shall be supplied with shutoff and bleed valves in the high and low sensing pick-up lines (3 valve manifolds).
- I. Temperature Control Cabinets: Controls shall be mounted in standard control cabinets, size as required, with hinged key locking door. Unit is to be piped and wired to numbered terminal strips. Items within panels shall be neatly labeled to identify them with respect to the control schematics. All control wiring and system communications shall be electrically terminated inside the cabinet.
- J. Electronic Room Thermostats: A modulating solid state controller with built-in detector, P or PI controller, as required, with continuous voltage or current output. Each unit shall have individual setpoint, proportional band, start-point, and span adjustments. Input voltage shall be 24 VAC or less. Provide each unit with night setback, summer/winter switch over, or remote reset capabilities, as required.

- K. Programmable Electronic Thermostats: A modulating solid state controller with built-in detector, P or PI controller, as required, with continuous voltage or current output. Each unit shall have individual setpoint, proportional band, start point, and span adjustments. Input voltage shall be 24 VAC or less. Provide each unit with night setback, summer/winter switchover, or remote reset capabilities, as required. Thermostat shall have a seven (7) day four (4) time sequence programmable schedule.
- L. Electric Room Thermostats: Heavy duty snap action type with key operators rated at 6 FLA at 120 VAC contacts suitable for the intended service. Provide manual selector switches as required in the sequence of operation.
- M. Low Limit Detection Thermostats: Low limit detection thermostats shall be of the vapor tension capillary type having a sensing element a minimum of 20 feet in length. These thermostats shall be manual reset type. The elements shall be complete with necessary fittings to permit installation in the duct or AHU to sense the correct discharge temperatures. One (1) low limit detection thermostat will be installed for every 20 square feet of protected area and arranged to sequence unit as described when sensed temperature falls below 38 degrees F.
- N. Insertion Thermostats: Remote bulb thermostats shall be relay-operated and have a linear scale, ambient temperature compensation, and adjustable proportional band. Remote bulb thermostats with sensing elements in air ducts shall have averaging sensing elements, except where temperatures below freezing exist and stratification could cause coil freeze-up. All remote bulb thermostats shall be panel mounted.
- O. Thermostat guards shall be provided where specified, indicated on control diagram, or indicated on floor plans. Guards shall be firmly attached to wall and thermostat cover shall be visible through guard. Covers shall be clear Lexan. Opaque covers shall be provided where specified.
- P. Water Level Sensor shall be probe type sensor with remote control mounting. Control enclosure is to be weatherproof NEMA 3R enclosure. Sensor housing is to be brass with painted aluminum die-cast electrical enclosure that conforms to vapor proof NEMA requirements. Manufacturer: McDonnell Miller or equivalent.
- Q. Time Clocks:
  - 1. Programmable start time clocks shall be utilized for providing the required occupied/unoccupied functions. The optimal start timer will be field adjustable so that start-up times may be varied up to four hours prior to operation of the building. Provide override switches integral with time clocks which will allow the operator of the system to completely override the time clock and index all systems controlled by an individual time clock to either occupied or unoccupied mode. These override switches are in addition to the separate override switches which may be required by the sequence of operation.
- R. Manual Override Timer: 0 - 12 hour spring wound override timer without "Hold Position."

## 2.09 SYSTEM HARDWARE IDENTIFICATION

- A. Wire Tags
  - 1. All multi-conductor cables in all pull boxes and terminal strip cabinets shall be tagged.
  - 2. Provide wire tags as per the requirements for Electrical Work contained in these Specifications.
- B. Conduit Tags
  - 1. Provide tagging or labeling of conduit so that it is always readily observable which conduit was installed or used in implementation of this Work.
- C. Miscellaneous Equipment Identification
  - 1. Screwed-on, engraved black lamicaid sheet with white lettering on all control panels, remote processing panels and items inside panel. Lettering sizes subject to approval.
  - 2. Inscription, subject to review and acceptance, indicating equipment, system numbers, and for panel interior wiring, input/output modules, local control panel device identification.

## PART 3 EXECUTION

### 3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Install all control components in accordance with manufacturer's instructions and recommendations.
- B. Mount control panels adjacent to associated equipment on vibration-free walls or free-standing angle iron supports. Verify panel locations and space availability prior to submission of shop drawings. The panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
- C. Do not install electronic hardware until appropriate environmental conditions have been established. Products installed in violation of this requirement shall be replaced at no additional cost to the project.
- D. Coordinate storage requirements for factory mounted terminal control units on air terminal devices.
- E. Each electrical field wire shall be labeled or coded at each end to show location of the opposite end. Each point of all field terminal strips shall be permanently labeled or coded. Color coded cable with cable diagrams may be used to accomplish cable identification and terminal strip identification.
- F. Provide temperature and humidity sensor guards in areas noted on the Drawings. Guards shall be firmly attached to the walls.

- G. Penetrations
  - 1. Provide firestopping for all penetrations though all fire proofed or fire stopped components used by dedicated BAS conduits and raceway. All openings in shall be closed using approved fire resistive sealant.
  - 2. All wiring passing through penetrations, including walls, shall be in conduit or enclosed raceway. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
  - 3. No penetrations in structural elements shall be made before receipt of written approval from the architect.
- H. Outside Air Sensors shall be mounted on the North wall or located in a continuous intake flow adequate to monitor outside air conditions.
- I. Building Differential Air Pressure Transmitter's exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind. The interior tip shall be in an inconspicuous location.
- J. Air Flow Measuring Stations installed in ducts shall be the same size and inside dimension as the duct.
- K. HVAC Output Devices
  - 1. All output devices shall be installed per manufacturer recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, etc.
  - 2. Electronic Signal Isolation Transducers: Whenever an analog output signal from the BAS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems.
- L. Graphic Displays
  - 1. Provide a color graphic system flow diagram display for each system with all points indicated. Provide Historical Data Viewer functionality.
  - 2. Provide a color graphic display for each floor in the facility. Indicate each HVAC zone, color coded to indicate zone values and status. Provide Historical Data Viewer functionality. Each floor plan shall include room numbers matched to the final room numbering scheme. Note that these may not be the same as the contract documents and shall be updated as part of the project at no cost.
  - 3. User shall penetrate from floor plan to associated HVAC system graphic.

### 3.02 ELECTRICAL SYSTEM INSTALLATION

- A. Provide electrical wiring for relays (including power feed) and for temperature and pressure indication.
- B. Provide power wiring, conduit and connections for low temperature thermostats, high temperature thermostats, alarms, actuating devices and for all temperature, humidity and pressure sensors. Conduit shall be continuous from the controller enclosure to the field device.
- C. Provide all other wiring required for the complete operation of the specified systems.

- D. Run all wiring raceway systems complying with the requirements of the National Electrical Code. All installations shall be installed in EMT or plenum rated cables.
- E. Conceal conduit within finished shafts, ceilings and wall as required.
- F. Plug or cap all unused conduit openings and stub-ups. Cap open ends of conduits until conductors are installed. Do not use caulking compound.
- G. Route all conduit to clear beams, plates, footings, and structure members. Do not route conduit through column footings or grade beams. All exposed conduit and cable shall be parallel/perpendicular to building lines.
- H. Penetration through outside foundation walls shall be sealed watertight with oakum and lead.
- I. Where conduit is attached to vibrating or rotating equipment, flexible metal conduit with a minimum length of 18 inches and maximum length of 36 inches shall be installed and anchored in such a manner that vibration and equipment noise will not be transmitted to the rigid conduit.
- J. Where exposed to the elements or in damp or wet locations, waterproof flexible conduit shall be installed. Installation shall be as specified for flexible metal conduit.
- K. Provide floor, wall, and ceiling plates for all conduits passing through walls; floors or ceilings. Use prime coated cast iron, split-ring type plates, except with polished chrome-plated finish in exposed finished spaces.
- L. Class 2 Wiring (24VAC or less)
  - 1. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5 feet from the building structure utilizing metal hangers designed for this application. All wiring shall be installed in accordance with local code requirements.
  - 2. Perform circuit tests using qualified personnel only. Provide necessary instruments and equipment to demonstrate that:
    - a. All circuits shall be continuous and free from short circuits and grounds. All circuits are free from unspecified grounds; that resistance to ground of all circuits is no less than 50 megaohms. All circuits are free from induced voltages.
    - b. Provide complete testing for all cables used under this Contract. Provide all equipment, tools, and personnel as necessary to conduct these tests.
    - c. Provide for complete grounding of all signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
- M. BAS Line Voltage Power Source
  - 1. 120 volt AC circuits used for the BAS shall be taken from panelboards and circuit breakers or junction boxes provided by the Electrical Contractor. Transformers shall be provided by the BAS contractor.
  - 2. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.
  - 3. Fan-powered terminal unit controllers may use AC power from motor power circuits.

- N. BAS Raceway
    - 1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2 inch.
    - 2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
  - O. In all communication conduits, provide one (1) spare twisted pair to be installed, tagged and labeled at each end.
  - P. Telephone lines, where required as a remote communication source, shall utilize voice band, non-switched, private line channels consistent with local telephone systems and shall be four-wire unconditioned 3,002 channels. The modems shall have twenty-five (25) pin EIA connectors and RS-232C interface.
  - Q. Communication conduits shall not be installed closer than 6 feet from high power transformers or run parallel within 6 feet of electrical high power cables. Care shall be taken to route the cable as far from interference generating devices as possible.
  - R. All shields shall be ground (earth ground) at one point only, to eliminate ground loops.
  - S. There shall be no power wiring, in excess of 30 VAC rms, run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, all communication wiring and signal wiring shall be run using separate twisted pairs (24-awg) in accordance with the manufacturer's wiring practices.
- 3.03 TERMINAL UNIT
- A. Furnish ASC to the terminal unit manufacturer for factory installation and wiring on the terminal units. Coordinate all required wiring terminations, hardware installations and testing procedures with the terminal device manufacturer.
  - B. Provide factory installation supervision and/or quality control checking of the installation to insure a complete and fully functional installation.
  - C. Avoid direct factory mounting of the microprocessor mother board, if possible. Provide a wiring harness to permit factory wiring of the ASC input/output hardware and eliminate the requirement for the microprocessor and associated electronics to be exposed to shipping and site storage environments. In the event this process cannot be accomplished, take care to insure that all electronic components are shipped and stored in a manner that avoids direct exposure to freezing weather conditions and moisture.
  - D. Load ASC setpoints, configuration requirements and calibration constants and test unit prior to finished ceiling installation. Submit for review a preliminary checklist for all ASC's installed indicating conformance.

### 3.04 INSTRUCTION OF OWNER OPERATING PERSONNEL

- A. All training at the site shall utilize specified manuals, as-built documentation, and the on-line help utility. All training sessions shall be videotaped with professional quality video camera and a dubbing/editing recorder. Submit two copies of the training session(s) prior to project contract completion.
- B. All Man Machine Interface Training (DOS, Windows, GUI, etc.) shall be provided by a professional trainer utilizing interactive computer screen projection and capabilities to train two members of the Owner operating staff with PC's of similar style and processing capabilities as the operator's terminal.
- C. The initial operator training program shall be to establish a basic understanding of Windows based software, functions, commands, mouse, etc. The training shall encompass as a minimum:
  - 1. Purge and/or dump of historical data.
  - 2. Use of OWS.
  - 3. Troubleshooting of input devices, i.e., bad sensors.
  - 4. Sequence of operation review.
  - 5. Sign on - sign off.
  - 6. Selection of all displays and reports.
  - 7. Commanding of points, keyboard, and mouse mode.
  - 8. Modifying English text.
  - 9. Use of all dialogue boxes and menus.
  - 10. Modifying warning limits, alarm limits and start-stop times.
  - 11. System initialization.
  - 12. Download and initialization of remote panels.
  - 13. Basic Windows (latest versions) Training.
  - 14. User Interface software.
  - 15. Network Management.
- D. Upon completion of the work and acceptance by the Owner, provide six four-hour periods of instruction to the Owner's operating personnel who have responsibility for the mechanical system. Provide two periods of training at the end of Construction Phase and two periods at the beginning of the first winter, and the remaining two at the beginning of the first summer. The Control Manufacturer shall make available to the Owner regularly scheduled training courses for the ongoing training of the Owner's operating personnel.

### 3.05 ACCEPTANCE PROCEDURE

- A. Upon completion of the installation, Contractor shall start up the system and perform all necessary calibration and testing to ensure proper operation of the project mechanical systems.
- B. Schedule a hardware demonstration and system acceptance test in the presence of the Owner's representative. The acceptance testing is defined as demonstrating the specified sequence of operation. The Contractor shall perform tests prior to scheduling the acceptance test and hardware demonstration to insure the overall system is ready for inspection and observations.



- C. When the system performance is deemed satisfactory by these observers, the system will be accepted for beneficial use and deemed substantially complete.
- D. System Acceptance: The BAS Contractor shall issue a report upon project completion stating that the system is complete, has been adjusted, and is operating in accordance with the Specifications. Any deviations from specified settings or operations necessitated during system adjustment shall be specifically noted.

### 3.06 COMMISSIONING

- A. Fully commission all aspects of the Building Automation System work.
- B. Acceptance Check Sheet
  1. Prepare a check sheet that includes all points for all functions of the BAS
  2. Submit the check sheet to the Engineer for approval one month prior to testing.
  3. Complete the check sheet for all items and functions of the BAS and initial each entry with time/date as record of having fully calibrated and tested the BAS. Submit to Engineer.
  4. The Engineer will use the check sheet as the basis for acceptance testing with the BAS Contractor.
- C. Provide all necessary specialist labor, materials, and tools necessary to demonstrate to the Engineer, that the BAS has been commissioned and is operating in compliance with the contract. Prepare a list of noted deficiencies signed by both the Engineer and the BAS Contractor.
- D. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

END OF SECTION

SECTION 23 09 93 - SEQUENCES OF OPERATION

PART 1 GENERAL

1.01 CONTROL DIAGRAMS AND SCHEDULE

- A. Provide a system of controls as required to accomplish the Sequences as hereinafter specified. Refer to the Drawings for information indicating the components and intended control functions and devices.
- B. Building Automation System (BAS) Contractor shall be responsible for all control wiring connections, auxiliary devices, and control wiring diagrams to complete the control system and attain the described sequence of operation.
- C. All set-points of thermostats, controllers and the like, that are not factory preset, shall be preset by the Temperature Control Contractor before system startup.
- D. The control system shall be easily expandable as the future equipment is installed with no control component replacements. All main system control panels shall have all inputs and outputs necessary for the future equipment.
- E. All temperature and pressure control set-points and time limits shall be adjustable at the BAS OWS.
- F. Through stable operation and control and sensor accuracy, the following control points shall be held within the following ranges:
- |   |   |
|---|---|
| 1. General occupied spaces (offices, conferences) | cooling setpoint + 1 degree<br>heating setpoint -1 degree |
| 2. Air handler discharge                          | +/- 1.0 degrees   |
| 3. Ducted Air                                     | ±1°F  |
| 5. Outside Air                                    | ±2°F  |
| 6. Dewpoint                                       | ±2°F  |
| 7. Water Temperature                              | ±1°F  |
| 8. Delta-T  | ±0.25°F   |
| 9. Relative Humidity                              | ±2% RH  |
| 10. Water Flow                                    | ±2% of full scale   |
| 11. Airflow (terminal)                            | ±10% of full scale  |
| 12. Airflow (measuring stations)                  | ±5% of full scale   |
| 13. Air Pressure (ducts)                          | ±0.1" W.G.  |
| 14. Air Pressure (space)                          | ±0.01" W.G.   |
| 15. Water Pressure                                | ±2% of full scale   |
| 16. Electrical (A, V, W, Power factor)            | ±1% of reading  |
- G. All temperature sensors in air handling units shall be averaging type sensors to average the reading across the cross-sectional area of the unit. Point type sensors are not acceptable.
- H. There are many interrelated control loops that will require tuning and adjustment to prevent "hunting" and excessive modulation. Allow time in the bid proposal for tuning and adjustment based on the actual construction and operation.

## 1.02 SAFETY INTERLOCKS - GENERAL

- A. All safety interlocks shall be hard wired and independent of control system programming software, and electronic controllers. These safety interlocks include the shutdown of equipment items due to low temperatures, shutdown due to lack of combustion air supply and/or proper flue draft for fuel fired equipment, and shutdown due to smoke detection.
- B. The Division 26 fire alarm panel shall contain one (1) set of contacts for each air handling unit that the Temperature Control Contractor shall be responsible for wiring through in order to shut down the air handling unit, associated return fans, and associated exhaust fans when smoke is detected by smoke detectors that report through the fire alarm panel. This safety interlock is in addition to smoke detectors located at the air handling unit that are locally hard wired by the Temperature Control Contractor for air system shut down of the air handling unit, associated return fans, and associated exhaust fans.
- C. Smoke Dampers (applies to AHUs 1,2,3&4): Smoke dampers and combination fire and smoke dampers shall be motor driven open, motor held open, and spring closed. Each smoke damper shall be operated by a duct mounted spot type smoke detector provided by the Division 26 Contractor located in the duct adjacent to the damper. The Temperature Controls Contractor shall be responsible for wiring between the smoke detector contacts and the damper motor and for the power wiring to the motor regardless of voltage.

## PART 2 PRODUCTS

- 2.01 Refer to Section 23 09 23 for applicable products.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Alarms: The system shall have multiple levels of action with each alarm. The BAS contractor shall review each alarm point with the Owner's representative to determine the range of alarms (if not already specified) and the appropriate action of each alarm within the system. The actions include changing colors on the graphic at the OWS, notification on the BAS, mobile device, email, etc.
- B. Setpoints: All setpoints in the BAS shall be adjustable within the BAS at the OWS.
- C. Air Handling Unit Damper Control: Each damper operator within an air handling unit shall be modulated from its own individual control signal from the BAS. Dampers shall have dedicated outputs. Linkage control or modulation of multiple dampers from a single signal is not acceptable.
- D. Air Handling Unit Temperature Sensors: All temperature sensors within air handling units shall incorporate an averaging element with a minimum length of 96 inches or the length needs to provide adequate coverage of the cross-section of the unit. The intent is to provide an average temperature throughout the unit. Provide capillary supports at the sides of the duct unit to support the sensing element.

- E. Tuning: Each control loop shall be tuned to eliminate unnecessary rapid changes, hunting and adverse impacts on other control loops.
- F. Isolation Valves: All equipment isolation valves shall be “slow-opening” and the actuation of the valves shall be coordinated with the equipment start to prevent the operating equipment from experiencing either low or high flow alarms.
- G. Motor Status: The status of all constant speed motors shall be determined by current sensing devices on the motor leads. The status of all motors with variable frequency drives (VFD) shall be via the fault status alarm on the VFD.
- H. Schedule: In consultation with the Owner’s Representative, create an operating schedule for all major equipment and systems, and for certain building areas. Some systems, equipment items, or areas will operate continuously, but operating schedule functionality shall be provided for all equipment/systems for future flexibility.

### 3.02 AIR HANDLING VARIABLE VOLUME MULTIZONE – DX COIL AND HOT WATER

- A. System Components
  1. Return Fan array with control panel and EC motors
  2. Mixing chamber with return, relief and outside air dampers
  3. Filter bank
  4. Supply Fan array with one control panel and EC motors
  5. Bi-polar ionization unit
  6. Cooling coil – DX with remote variable refrigerant volume (VRV) outdoor heat pump units
  7. Heating coil – Hot water with Circulating pump
- B. Schedule: The unit shall operate continuously in accordance with the Owner’s schedule.
- C. System Off State
  1. When the unit is off for any reason, the outside air, relief and any associated smoke dampers shall be closed. The return air damper shall be fully open. The return fan array, and the supply fan array shall be off. The cooling coil valves shall be closed. The heating coil valve shall be closed unless indicated otherwise following. The heating coil pump shall remain in operation as described following.
- D. Start-up
  1. Optimized Start – The unit will be indexed to this state based on an optimal start algorithm that considers outside air temperature and space temperature to estimate the amount of time necessary to bring the space to occupied temperatures at the scheduled occupied time.
  2. Start-up – All associated smoke dampers shall open. The outside, relief and return dampers shall remain in their “off” position. The return fan shall start first. After proof of return fan operation for 10 seconds, then the supply fan shall start. Both shall run at minimum speed. Once a run status is indicated, the fans shall slowly ramp to maintain their normal setpoint control operation. Fans shall run continuously when the schedule is in occupied mode.

3. Warm-up – If more than three (3) sensors served by a particular AHU indicate space temperature is more than 5 degrees F below setpoint, the unit shall be released to control to the full heating mode. The unit discharge air temperature shall be set to maximum value. As the space temperature reaches setpoint and after a minimum 3 minute run time, the unit shall be slowly released to occupied control.
  4. Cool Down – If more than three (3) sensors served by a particular AHU indicate space temperature is more than 3 degrees F above setpoint, the unit shall be released to control in the full cooling mode. The unit discharge air temperature shall be set to minimum value. As the space temperature reaches setpoint and after a minimum 3 minute run time, the unit shall be slowly released to occupied control.
- E. Occupied Operation
1. Minimum Outside Air Damper Control – The outside air, return air and relief air dampers shall each be actuated by individual control outputs. Once released to normal control, the outside air and return air dampers shall slowly modulate to the minimum outside air position. After 3 minutes of operation at minimum outside air position, the dampers shall be released to control to their setpoint as required by economizer or ventilation control loops. Minimum outside air is achieved by a single outside air damper, in response to an air flow measuring station.
  2. Discharge Air Temperature Setpoint
    - a. The discharge air temperature setpoint shall be linearly reset from a minimum of 55 degrees F at 55 degrees F outside air temperature to a maximum of 60 degrees F at 35 degrees F outside air temperature.
    - b. After the supply duct static pressure has been reset to its minimum setting, all of the spaces associated with the air handling unit are operating at their setpoint, and the terminal heating coils are operational, then the unit setpoint temperature shall be raised by 0.5°F. If the unit discharge air temperature has been reset and any space is more than 2°F above setpoint, then the discharge air temperature shall be reduced by 0.5°F. If the return air humidity is above 55%, then the discharge air temperature shall be reduced by 2°F. A 10 minute delay shall be utilized between each increase/decrease in the discharge air temperature before making additional changes. The minimum and maximum discharge air temperature setpoint shall be 53 to 64 degrees F.
  3. Discharge Air Temperature Control: A controller with a discharge air temperature sensor in the discharge plenum of the unit shall maintain discharge air temperature through energizing the VRV outdoor heat pump units, economizer damper modulation, and heating coil control valve modulation. All control actions shall be the result of a slow acting PID control loop. The heating coil shall only operate while the VRV outdoor heat pump units are in cooling when required for dehumidification.
    - a. Outside Air Temperature Above 67 Degree F: The outside air damper, and the return damper, and shall be controlled by the ventilation control loop to bring in the minimum outside air required. The discharge air controller shall modulate the cooling operation mode of the VRV outdoor heat pump units to maintain the discharge air temperature setpoint. The heating coil valve shall be closed.
      - 1) VRV systems are to operate in cooling mode
      - 2) Each VRV system is to be staged on and modulated with a 0-10VDC signal as needed to satisfy the discharge air setpoint. Systems are to be rotated to equalize runtime by the DDC contractor.

- 3) Each VRV system has (2) EKEXV500 expansion valves kits and (2) EKEQ control boxes associated with it. It is required that each control box on a VRV system receive the same 0-10VDC signal from the DDC system.
  - b. Outside Air Temperature below 65 Degrees F (adjustable) and OA enthalpy is less than 22 btu/lb (adjustable) and OA temp is less than RA temp and the supply fan status is on. The BAS shall control the economizer dampers to the full outdoor air positions. Discharge air temperature shall be controlled by the modulation of the cooling coil valve until the cooling coil valve is fully closed. Then, the discharge air temperature shall be controlled by the modulation of the economizer dampers by the mixed air controller. When the outside air damper reaches its minimum ventilation position as indicated by the ventilation control loop, for 2 minutes, the dampers shall then be controlled to the ventilation control signal and the discharge air temperature shall be controlled by the modulation of the heating coil control valve. Any time the MA temp drops below the 45 degrees F to 40 degrees F (adjustable), the BAS will override normal economizer maximum position from 100% to 0% (adjustable).
    - 1) The BAS system will send a heat or cool command and a 0-10 volt signal to the VRV. The BAS shall have an OA Switchover Temperature above which the VRV can be used as the primary heating source is desired by the Owner. The BAS shall also have the option to put the VRV into heating mode if deemed advantageous based on utility rates.
    - 2) Each VRV system is to be staged on and modulated with a 0-10VDC signal as needed to satisfy the discharge air setpoint. Systems are to be rotated to equalize runtime by the DDC contractor.
    - 3) Each VRV system has (2) EKEXV500 expansion valves kits and (2) EKEQ control boxes associated with it. It is required that each control box on a VRV system receive the same 0-10VDC signal from the DDC system.
4. Supply Fan Control
  - a. A remote duct static pressure sensor and controller shall measure duct pressure and modulate the fan array speed to maintain the static pressure setpoint. Fan speed control shall be by way of ECM modulation. The sensor shall be located at two-third (2/3) the system distance from the AHU. The initial setpoint shall be equal to the initial TAB setpoint and shall be optimized by the balancing contractor. The ECMs in fan arrays require separate speed signals from the fan array control panel.
  - b. Pressure Reset: The BAS shall monitor all terminal box damper positions associated with the AHU. The static setpoint shall be reset based on VAV box position. If all boxes are below 80% of full open, reset the static setpoint downward 0.05" w.g. every 10 minutes until at least one VAV box is at least 80% open. If any box is more than 90% open, reverse the sequence. The setpoint low limit shall be 0.5" w.g. below initial setpoint and the high control unit setpoint shall be 0.5" w.g. above the initial setpoint.
  - c. Supply air flow shall be indicated by the summation of the air flows at all associated terminal boxes.
5. Return Fan Control
  - a. The return fan array speed shall modulate to maintain a +0.25" static pressure in the return fan discharge plenum. Fan speed control shall be by way of ECM modulation. An air flow monitoring station at the fan inlets shall monitor fan air flow quantity. The pressure setpoint shall be verified during balancing and adjusted to provide necessary air flow from the return fan in full economizer mode. The ECMs in fan arrays require separate signals from the BAS but will drive all fans at the same speed.

6. Relief Damper Control: The damper shall be modulated, via PI control loop, to maintain the building pressure at 0.03" positive relative to the outside. Provide a space differential pressure sensor (relative to outdoors) for each AH system. Provide sensors in the following locations.
    - a. AHU1: In the vicinity of Second Floor Elevator Vestibule.
    - b. AHU1: In the vicinity of Third Floor Elevator Vestibule.
    - c. AHU2: Basement Elevator Lobby adjacent to Men's Shower B018A and Women's Shower B019A.
    - d. AHU2: In the vicinity of First Floor Vestibule 1001.
    - e. AHU3: In the vicinity of First Floor North Entry 1080.
    - f. AHU4: First floor adjacent to Stair S5 and Book Drop Vestibule 1042.
  7. Filter Differential Pressure
    - a. Differential analog pressure measuring sensors that provide a differential pressure readout located across the filter bank shall report to the BAS. Each filter shall alarm when pressures exceed three (3) times the initial pressure drop, 0.90 inch. System shall alarm if the pressure drop is below the design initial pressure. The use of switches that only trigger alarm at a setpoint are not acceptable.
  8. Outside Air Flow Air Flow Measurement Station (AFMS): An outside air flow measuring station (AFMS) shall be monitored by the BAS. The BAS shall control the minimum outside air quantity by modulating the return air damper, and single outside air damper to provide the specified minimum ventilation. Return air damper shall modulate with a dedicated control signal based on the outside air intake airflow measuring station. The air balance shall establish initial damper positions so that the return damper is as much open as possible. Relief dampers shall control as specified previously. The AFMS shall be mounted in the outside air plenum directly downstream of the outside air louver.
  9. Heating Coil Pump (AHU 1,2,3&4)
    - a. On a call for heating or when the outside air temperature is below 40 degrees F, the heating water circulating pump shall start and operate continuously, regardless of unit operating state.
    - b. Pump operation shall be monitored by current sensing relay.
    - c. If the air handling unit is off, a temperature sensor in the leaving coil piping shall modulate the control valve to maintain 70°F leaving water temperature.
  10. Bi-polar ionization: The bi-polar ionization units in the air handling unit shall be operational when the unit is operational.
- F. Unoccupied Operation
1. When the unit is scheduled to unoccupied, the system shall be in the off state described previously.
  2. Heating: Whenever two spaces served by the unit are below a space temperature of 63 degrees F, the unit shall be indexed to run in warm-up mode. The unit dampers shall remain in the "off" configuration. The system shall run until all spaces are above 65 degrees F, then it shall return to unoccupied mode.
  3. Cooling: Whenever two spaces served by the unit are above a space temperature of 82 degrees F, the unit shall be indexed to run in cool down mode. The unit dampers shall remain in the "off" configuration. The system shall run until all spaces are below 80 degrees F, then it shall return to unoccupied mode.
  4. AHU5 and AHU6 shall operate in Occupied mode, but shall have the Unoccupied Operation available should the Owner choose to use it.
- G. Demand Control Ventilation (AHUs 1,2,3&4)

1. Minimum Outside Air with CO2 Override
  - a. Provide a CO2 sensor in the AH return duct main and in each high occupancy room. If a CO2 sensor level rises above 1000 ppm, the associated AHU minimum outside air shall be increased from the lower CFM minimum position to maintain 1000 ppm CO2, but shall open no more than the upper minimum OA CFM position. Following is for lower and upper limits, and to assist the Balancing Contractor in setting the damper position to equate to the lower and upper limits.
    - 1) 50,000 CFM supply
    - 2) 45,000 CFM return
    - 3) 10% (5,000 CFM) Min. Minimum OA
    - 4) 20% (10,000 CFM) Max. maximum OA
    - 5) Economizer function shall over-ride the upper limit.

H. Safeties

1. Smoke Detector: The BAS shall, upon receiving a signal from the smoke detector in the supply and/or the return air stream, or the building fire alarm system, shall disable the air handling system and index the system to the "off" state. The system shall not be allowed to operate until the fire alarm is cleared and the system is manually reset.
2. Freezestat: A low temperature cutout shall, upon sensing a temperature below 38 degrees F at any point, open the preheat coil control valve, close both outside air dampers and the relief damper, open the return air dampers and shut off the fans.
3. High Supply Static Pressure: A high limit static pressure sensor located at the air handler discharge duct or plenum, set at 0.5 inch below the supply duct design static pressure shall override the speed of the supply fan system to prevent higher pressure and shall alarm the BAS. Alarm shall automatically reset when pressure decreases 0.25" below setpoint. If pressure reaches the supply duct design static pressure, the supply fan system shall be stopped, and the BAS alarmed. Manual reset shall be required to restart the AHU system.
4. High Negative Return Static Pressure: A high negative limit static pressure sensor located at the air handler return duct or plenum, set at 0.5 inch above the return duct design static pressure shall override the speed of the return fan system to prevent higher negative pressure and shall alarm the BAS. Alarm shall automatically reset when pressure decreases 0.25" below setpoint. If pressure reaches the return duct design static pressure, the return fan system shall be stopped, and the BAS alarmed. Manual reset shall be required to restart the AHU system.
5. Return fan high static: A high limit static pressure sensor located in the chamber downstream of the return fan shall alarm the BAS.
6. Supply fan low static: A high negative limit static pressure sensor located in the chamber upstream of the supply fan shall alarm the BAS.
7. Smoke Damper Alarm and Shutdown: The BAS shall, upon receiving a signal from the smoke detector controlling smoke dampers at the shaft branched, or the building fire alarm system, shall disable the air handling system and index the system to the "off" state. The system shall not be allowed to operate until the fire alarm is cleared and the system is manually reset.

I. Emergency Power Operation

1. Unit shall remain off until power is restored.
2. Unit shall operate fully on emergency power. Upon loss of power, the unit shall restart as soon as possible and fans and dampers slowly ramp to the previous state of operation.



- J. Alarms: In addition to those indicated above, alarms to the BAS shall include, but not be limited to the following. Unless noted otherwise, these shall automatically reset if the alarm condition clears.
1. Fan Status: The status of each fan shall be monitored by VFD interface. Status of fans that do not utilize VFDs shall be monitored by current sensing relays. .. Whenever the fan status does not match the command point for a period of 15 seconds. In an array, all inputs shall toggle a single common alarm status.
  2. Each ECM supply and return fan arrays shall be provided with an advanced airflow control panel that is integrated into the BAS. The status of each fan shall be monitored by the airflow control panel and made visible through the BAS.
  3. Mixed air temperature below 40 degrees F.
  4. High Discharge Air Temperature: 5 degrees F above setpoint.
  5. Low Discharge Air Temperature: 5 degrees F below setpoint.
  6. Supply fan static pressure out of limits (too high and too low)
  7. Return fan static pressure out of limits (too high and too low)
  8. Fire Alarm Shutdown
  9. Low Limit Thermostat Shutdown
  10. High Filter Static Pressure
  11. Circulating pump status does not match command point
  12. Coil pump status does not match the command status
- K. Graphic Interface: The graphic at the BAS User Interface shall include a system diagram complete with, but not limited to, the following information:
1. Outside Air Temperature
  2. Outside Air Humidity
  3. Outside air, return air, relief air damper position via BAS output signal
  4. Building differential pressure
  5. Outside air flow (AFMS)
  6. Mixed air plenum temperature (upstream of filter)
  7. Heating coil leaving air temperature
  8. Heating coil valve position - BAS output signal
  9. Circulating pump run status
  10. Heating coil leaving water temperature.
  11. Cooling coil leaving air temperature
  12. Supply fan status
  13. Supply plenum static pressure
  14. Supply duct pressure (both actual and setpoint)
  15. Supply fan air flow via Sum of terminal boxes
  16. Filter static pressure drop
  17. Discharge air humidity
  18. Humidifier control valve position
  19. Space Humidity
  20. Unit discharge air temperature (both actual and setpoint)
  21. Return air temperature
  22. Return air humidity
  23. Return fan status
  24. Return plenum static pressure
  25. Return duct pressure (both actual and setpoint)
  26. Return plenum pressure
  27. Return air flow (AFMS)

28. Bi-polar ionization run time
29. Bi-polar ionization status
30. Alarm status as indicated above
31. DX coil status (heating or cooling)
32. Primary heating source (DX or HW)
33. OA switchover temperature

### 3.03 EXHAUST FANS

- A. General: The status of all fans shall be monitored, and the BAS shall be alarmed whenever the fan status does not match the command point.
- B. Penthouse Heat Relief Fans: A temperature sensor in the space shall, upon sensing a temperature above 85 degrees F (adjustable), open the intake air damper and start the fan. When the sensed temperature is 2 degrees F below setpoint, the fan shall stop and the damper close. The BAS system shall be alarmed when the space temperature exceeds setpoint by 5 degrees F.

### 3.04 REFRIGERANT MONITOR SYSTEM

- A. A refrigerant monitor panel and sensing ports shall be furnished by the VRV manufacturer. The set-up, wiring and sequence shall be by the BAS provider.
- B. Upon sensing a refrigerant level equal to the Threshold Exposure Limit (TLV) of the furnished refrigerant, the monitor shall open the mechanical space intake ventilation dampers and signal the mechanical room exhaust fan to full airflow. The panel shall sound an audible alarm (manually silenced through BAS) and start two strobe lights (one on the panel and one remote), an alarm shall also be sent to the BAS system.
- C. Upon sensing a level of refrigerant at the Short-Term Exposure Limit (STEL) of the furnished refrigerant, the monitor shall light a strobe with a different color light and send another alarm to the BAS system.
- D. Upon sensing a level at the Emergency Exposure Limit (EEL) of the refrigerant furnished, the monitor shall re-sound the audible alarm, light a red strobe light and send a third alarm to the BAS system.

### 3.05 TERMINAL EQUIPMENT

- A. Penthouse Unit heaters: A wall or unit mounted temperature sensor, via DDC controller, shall cycle the fan to maintain space temperature requirements. When outside air temperature is above 50 degrees F, the control valve shall close the hot water supply to the units.
- B. Maintain sequences for existing terminal equipment outside the scope of this project.

### 3.06 VARIABLE FREQUENCY DRIVE

- A. The following points shall be by wired interface to the BAS system:
  1. Start/stop command
  2. Speed signal

3. Run status
  4. Fault status
- B. Provide RS-485 connection to the interface in each VFD to provide full interface and feedback from the VFD. The following points shall be integrated into the BAS:
1. Speed
  2. Frequency
  3. Voltage
  4. Amperage
  5. Kilowatts
  6. Run hours
  7. H-O-A Status
  8. Fault
- 3.07 Temporary Heating and Cooling During Construction:
- A. General: Control of the temporary heating and cooling system consisting of RTU1, RTU2 and RF7 shall be independent of the BAS. The equipment shall be started manually and controlled by internal controls. Provide a supply air temperature sensor in the temporary supply duct. Airflow shall be constant volume and discharge air temperature shall be 55 degrees F (adjustable). Provide a duct static pressure sensor in the supply duct. Control to initial setting of 2.0 inwg (adjustable). Adjust as needed to achieve required duct static pressure for proper terminal box operation. Provide a return air temperature sensor in the temporary return duct upstream of RF7. Provide a duct static pressure sensor in the return duct upstream of RF7. Control to initial setting of 1.0 inwg (adjustable). Adjust as needed to achieve required duct static pressure for proper building pressurization.
- 3.08 MISCELLANEOUS
- A. All sensing points of the miscellaneous systems shall be programmed for monitoring and alarms shall report to the OWS.
- 3.09 TREND REPORTS
- A. It shall be possible to trend all BAS data without having to program points or set-up. Trended points and times shall be set in conjunction with the Owner's requirements and the Commissioning Agent. Data storage processes shall be set to maintain this data for time constraints coordinated with the Owner. All points shall be recorded and stored every thirty minutes:

END OF SECTION

## SECTION 23 21 13 - HVAC WATER PIPING

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Provide complete piping systems for the following:
  - 1. Heating Hot Water

### PART 2 PRODUCTS

#### 2.01 PIPING

- A. 2 Inches and Smaller: Type "L" hard copper (ASTM B88).
- B. 2 1/2 Inches through 4 Inches: Schedule 40 black steel (ASTM A53, Type F) or Type "L" hard copper (ASTM B88).
- C. 5 Inches and Larger: Schedule 40 electric welded steel (ASTM A53, Type E, Grade B).
- D. For underground piping, refer to Section 23 20 05, "Underground Insulated Piping System."

#### 2.02 JOINTS AND FITTINGS

- A. 2 Inches and Smaller: Wrought copper socket solder (ANSI B16.22) or brazed (ANSI B31.1) joints.
- B. Larger than 2 inches: Forged steel butt welding (ASTM A234) or brazed wrought copper (ASTM B88).
- C. Grooved Mechanical Piping System (Up to 225°F, 2" and larger)
  - 1. Any Contractor who has installed at least five (5) grooved mechanical piping systems may use mechanical grooved couplings and fittings on 2 inches-24 inches roll grooved standard weight Schedule 40 pipe.
  - 2. Grooved mechanical piping systems shall be installed according to manufacturer's instructions. The manufacturer shall perform on-site installation demonstrations to the installing contractor before grooved coupling installation begins. Installing contractor shall verify that couplings are tightened to manufacturer's instructions.
  - 3. Grooved isolation valves, check valves, balance valves, strainers, and specialties are accepted when grooved method is utilized. Isolation valves, check valves, balance valves, strainers, and specialties shall meet the requirements of sections 23 05 02 "HVAC Specialties" and 23 05 23 "HVAC Valves."
  - 4. Victaulic Manufacturing Co. or Anvil Gruvlok.

D. Copper Press Fitting Joining System

1. If permitted by local authorities, copper pipe may be mechanically joined by copper or bronze compression fittings. Fittings shall carry a 50-year manufacturer's warranty.
  - a. Use shall be limited to systems with maximum operating pressure of 200 psi, and maximum operating temperature of 210 degrees.
  - b. Fittings 1/2 inch to 3 inches shall be crimped on both sides of an integral bead containing an EPDM seal. Fittings 2 1/2 inches through 3 inches shall be double crimped, and be fitted with a stainless steel grip ring.
  - c. Piping shall be Type "L" copper.
  - d. The Contractor shall be trained on the installation of the product by the manufacturer and shall follow the manufacturer's installation instructions.
  - e. All valves and specialties must conform to all other requirements of these Specifications.
2. Material:
  - a. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Fittings shall have a feature which allows the installer to quickly and easily identify connections which have not been pressed prior to putting the system into operation.
3. Acceptable Manufacturers:
  - a. Rigid-Viega, Nibco, Apollo, or Anvil

2.03 GASKETS

- A. 1/8 inch thick SBR rubber material with cloth finish on systems operating up to 150 psig and 200 degrees F (Garlock 91 or equivalent).
- B. 1/16 inch thick synthetic material with SBR binder on systems over 200 degrees F, or over 150 psig, but not concurrently (Garlock "Blue-Gard" or equivalent).

2.04 SOLDER AND BRAZING ALLOYS

- A. Size 2 inches and less shall be lead-free, 95/5 Tin-Antimony (ASTM B32).
- B. Joints in copper pipe larger than 2 inches shall be made with an alloy filler material with a melting point of not less than 1,000 degrees F, conforming to AWS A5.8, Class BCuP-5.
  1. J. W. Harris, or Harmon & Handy.

2.05 WELDING

- A. Joint surfaces shall be properly cleaned and welded with an approved filler material (ANSI B31.1, B31.9), per one of the following methods:
  1. Shielded Metal Arc (SMAW)
  2. Submerged Arc (SAW)
  3. Flux Cored Arc (FCAW)

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

- A. Do not run piping over or within 3 feet of electrical switchgear, panels, or similar equipment.
- B. Install mains without pitch. Use eccentric reducing couplings where pipe size changes, but keep top of all pipes at same elevation on liquid services.
- C. Install air vents at high points of branch lines to equipment.
- D. Install swing joints at all branch lines to equipment.
- E. Pitch branch piping not less than 1 inch per 10 feet of run. Branches shall be made from the top of the main.
- F. Installation of copper piping systems requires the use of approved bronze body valves and specialties or dielectric isolation of all ferrous components.

3.02 TESTING

- A. Flush all piping to clear dirt and debris.
- B. Fill with water and test at 125 psig for six (6) hours with no drop in pressure.
- C. Visually check for leaks. Repair and retest to establish leak-free system.

END OF SECTION

## SECTION 23 21 16 - CONDENSATION DRAIN AND MAKE-UP WATER PIPING

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Provide a complete piping system for the following:
  - 1. Condensation drain

### PART 2 PRODUCTS

#### 2.01 PIPING

- A. Interior piping: Type "L" hard copper tubing (ASTM B88).

#### 2.02 JOINTS AND FITTINGS

- A. Interior Piping Copper: Wrought copper socket solder (ANSI B16.22) joints.
- B. Copper Press Fitting Joining System
  - 1. At Contractor's option, and if permitted by local authorities, copper pipe may be mechanically joined by copper or bronze compression fittings. Fittings shall carry a 50-year manufacturer's warranty.
    - a. Use shall be limited to systems with maximum operating pressure of 200 psi, and maximum operating temperature of 210 degrees.
    - b. Fittings 1/2 inch to 3 inches shall be crimped on both sides of an integral bead containing an EPDM seal. Fittings 2 1/2 inches through 3 inches shall be double crimped, and be fitted with a stainless steel grip ring.
    - c. Piping shall be Type "L" copper.
    - d. The Contractor shall be trained on the installation of the product by the manufacturer and shall follow the manufacturer's installation instructions.
    - e. All valves and specialties must conform to all other requirements of these Specifications.
  - 2. Material:
    - a. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Fittings shall have a feature which allows the installer to quickly and easily identify connections which have not been pressed prior to putting the system into operation.
  - 3. Acceptable Manufacturers:
    - a. Rigid-Viega, Nibco, Apollo, or Anvil]

#### 2.03 SOLDER

- A. 95/5 Tin-Antimony (ASTM B32).

PART 3 EXECUTION

3.01 INSTALLATION OF CONDENSATION DRAIN PIPING

- A. Provide trapped condensation drain piping from outlets of drain pans of all cooling coils.
- B. Install insect screen at outdoor terminations.
- C. Provide drain piping from drain valves and overflows.
- D. Pitch all condensation lines down a minimum of 1 inch in 8 feet in the direction of flow.
- E. Provide full size interior piping cleanouts consisting of plugged tees at all changes of direction and where shown on the Drawings.
- F. Where cleanouts occur below carpet, provide vandalproof stainless steel carpet marker.

3.02 INSTALLATION OF MAKE-UP WATER PIPING

- A. Coordinate final connection with the Plumbing Contractor.
- B. Run piping level.
- C. Test at 125 psig for six (6) hours with no drop in pressure.

END OF SECTION



SECTION 23 23 05 - REFRIGERANT PIPING SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION

- A. Provide refrigerant piping between the indoor units and outdoor condensing units. Install oil and refrigerant charge, and test system.

PART 2 PRODUCTS

2.01 REFRIGERANT PIPING

- A. Hard drawn, Type "L" copper tubing (ASTM B88), cleaned and capped.

2.02 FITTINGS

- A. Wrought copper or wrought bronze fittings (ANSI B16.22) with brazed joints.

2.03 BRAZING ALLOYS

- A. 45% Silver/phosphorous, or silver/zinc alloys with a melting point greater than 1,000 degrees F.
  - 1. Handy and Harmon or Airco Welding Products.

2.04 SERVICE VALVES

- A. Henry Type 203 or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Clean ends immediately before brazing joints. Plug ends to exclude dirt and foreign matter during construction.
- B. Adequately support tubing with consideration for expansion, contraction, and vibration.
- C. Provide adequate lift traps for hot gas riser.
- D. Maintain a continual flow of inert gas (nitrogen) through the tubing while brazing joints.

3.02 LEAK TESTING

- A. After refrigerant piping system is completed, but before insulation is applied, the system shall be thoroughly tested for leaks. Nitrogen at 300 psig may be used for initial test; loss of initial pressure must be zero psig after a duration of four (4) hours.

- B. After system is tight, all inert gas shall be evacuated. Full refrigerant charge for proper operation shall be furnished and placed in the system by this Contractor. System shall be leak tested with halide leak detector after installation of refrigerant. All defective materials shall be replaced. Leaking joints shall be completely re-done, and the entire testing procedure performed again.
- C. Upon completion of testing, but before insulation is applied, piping shall be inspected by a representative of the governing authority.

END OF SECTION

## SECTION 23 31 12 - ACOUSTICALLY INSULATED DOUBLE WALL DUCTWORK

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. This selection specifies the construction of acoustically insulated double wall ductwork for both low pressure (2 inches W.C. or less) and high pressure (over 2 inches W.C.) installations. Each duct system shall have a single pressure classification, which shall exceed the fan's external static rating listed in the equipment schedules. In cases where an external fan static is not given in the equipment schedules, the pressure classification of the duct system shall exceed the fan's total static rating.
- B. Provide acoustically insulated double wall ductwork for the following:
  - 1. All temporary supply and return ductwork
- C. Include all duct fittings, volume dampers, duct access panels, wall and ceiling access panels, flexible connections, flexible duct, duct sealing systems, hangers and supports necessary to complete the indicated and specified system and achieve the desired system operation.

#### 1.02 QUALITY ASSURANCE

- A. The listed standards are referenced for the contractor to follow for the construction of acoustically insulated double wall ductwork items not specifically addressed in this specification. This specification takes precedence over the referenced standards.
- B. Standards:
  - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), Sheet Metal and Air Conditioning Contractors National Association (SMACNA), National Fire Protection Association (NFPA), and Underwriters' Laboratories (UL).
  - 2. SMACNA "HVAC Duct Construction Standards Metal and Flexible" – ANSI 2006 edition. Construct ductwork to meet all functional criteria defined in the SMACNA standards except where superseded by this Specification. Note: Duct constructions compliant with SMACNA standards that do not meet the minimum duct thickness listed in this Specification are not acceptable.
  - 3. SMACNA "Round and Rectangular Industrial duct Construction Standards." This is to be used for return duct subject to negative pressures greater than 4 inches W.C. Construct ductwork to meet all functional criteria defined in the ANSI 2006 SMACNA standards except where superseded by this Specification. Note: Duct constructions compliant with SMACNA standards that do not meet the minimum duct thickness listed in this Specification are not acceptable.
  - 4. SMACNA "HVAC Air Duct Leakage Test Manual" latest edition.
- C. All ductwork and fittings must have a computer generated label affixed to each section detailing all applicable information including the duct dimensions, gage, reinforcement type/class, and connector type of systems manufacturer. In addition, galvanizing thickness and country of origin must be clearly stenciled on each duct section.

- D. The Engineer reserves the right to randomly check sheet metal gauges and reinforcing to verify all duct construction is in compliance. Non-conforming material will be replaced by the Contractor at no cost to the Owner.

### 1.03 SUBMITTALS

- A. Submit ductwork fabrication and layout shop drawings in accordance with Section 20 05 15, "Submittals." Coordinate the detailed fabrication drawings with all trades. Coordinate size and location of ductwork with structure, piping, lighting, equipment, conduit, bus ducts, ceiling construction and clear height above ceilings and other items which may present a potential conflict.
- B. Layout drawings shall be at 1/4 inch = 1 foot scale on reproducible media with enlarged sections, elevations, plan drawings, and mechanical room drawings as necessary to ensure a coordinated installation.
- C. Provide a written program outlining protection of ductwork from contamination with dirt and procedures for cleaning contaminated ductwork.
- D. Submit documentation that the minimum two weeks building 100% outside air flush-out was completed, including dates when the flush-out was begun and completed and what steps were taken to guarantee 100% outside air usage.
- E. Submit documentation for the filtration media used during the flush-out period, including filtration media manufacturer's name, model number, and MERV value.
- F. Submit documentation that all filtration was replaced immediately, prior to occupancy including filtration media manufacturer's name, model number, and MERV value.
- G. Low Emitting Materials Documentation:
  - 1. Provide a cut sheet and a Material Safety Data Sheet for each adhesive used in the building highlighting compliance with Specification requirements.
  - 2. Provide a cut sheet and a Material Safety Data Sheet for each sealant used in the building highlighting compliance with Specification requirements.

### 1.04 DUCT DIMENSIONS

- A. The dimensions indicated on the contract drawings are the net inside clear dimensions available for air flow.
- B. Contractor shall allow for shop-lined or exterior insulation thickness as required and indicate this on the ductwork layout shop drawings.

## PART 2 PRODUCTS

### 2.01 DOUBLE WALL DUCTWORK AND FITTINGS

- A. All double wall ductwork and fittings shall be constructed with an outer galvanized wall and a perforated inner galvanized liner.
  - 1. Ductwork will be spiral seam construction made from G-90 or better galvanized steel conforming to ASTM A653/A653M and A924/A924M Standards, Lock-Forming Quality (LFQ). G-60 galvanized steel is not acceptable.
  - 2. Provide a perforated inner liner with 3/32 inch diameter holes, staggered on 3/16 inch centers, having a 23% open area. In rectangular ducts, wrap duct ends of each duct section at each joint with lining and tack weld lining to outer shell TDC flange.
  - 3. Provide a 1 inch fiberglass insulation material between the inner liner and the outer wall, wrapped in a mylar lining. The insulation material shall have a maximum thermal conductivity of 0.27 (BTU-in/hr. sq. ft. degree F) and shall meet the UL flame spread rating of 25 and smoke development rating of 50.
- B. Elbows shall be welded seam or standing seam construction.
- C. Diverging and converging flow fittings shall be constructed with radiused entrances without any projections into the air flow area of the main or branch duct.
- D. Flange connections are to be used for round ductwork sizes 36 inches or greater and for all flat oval ducts with a major axis greater than 42 inches.
- E. Provide Lockformer TDC flanges on rectangular ducts.
- F. Transverse joints shall not be considered as duct reinforcement unless specifically stated and listed in the SMACNA standard.
- G. Rectangular elbows shall be centerline radius, 1.5 times duct width. Short radius (1D) elbows or square throat mitered elbows are only to be used where shown on the drawings. The drawings shall indicate the style of elbow to be provided. Square throat 90 degree elbows shall include turning vanes. Square throat elbows that are less than 90 degrees shall not contain vanes.
- H. The following fittings are strictly prohibited: square throat with radius heel elbows, gored elbows, and drop cheek elbows.

### 2.02 DUCT GAUGES FOR DOUBLE WALL DUCTWORK

- A. Provide minimum outer wall duct construction gauges for round, flat oval, and rectangular duct systems with pressures up to 2 inches W.C., matching those listed for single wall ducts in Section 23 31 10, "Low Pressure Ductwork" as included in these Specifications. Use the actual outer wall dimensions to determine construction requirements.
- B. Provide minimum outer wall duct construction gauges for round, flat oval, and rectangular duct systems with pressures 2 to 10 inches W.C., matching those listed for single wall ducts in Section 23 31 11, "High Pressure Ductwork" as included in these Specifications. Use the actual outer wall diameter to determine construction requirements.

- C. Provide 26 gauge perforated liner for ducts with inner liner dimensions of 24 inches or less. Provide 22 gauge perforated liner for ducts with inner liner dimensions of 25 inches up to 84 inches.

#### 2.03 ROUND DOUBLE WALL DUCT FITTING GAUGES

- A. Provide minimum outer wall duct fitting construction gauges as required in Section 23 31 10, "Low Pressure Ductwork" and Section 23 31 11, "High Pressure Ductwork". Use the actual outer wall diameter to determine construction requirements. Provide 22 gauge perforated liner material for fittings with inner liner dimensions of 58 inches or less. Provide 20-gauge perforated liner material for ducts with inner liner dimensions of 59 inches up to 84 inches.

#### 2.04 FLAT OVAL DOUBLE WALL DUCT FITTING GAUGES

- A. Provide minimum outer wall duct fitting construction gauges as required in Section 23 31 10, "Low Pressure Ductwork" and Section 23 31 11, "High Pressure Ductwork". Use the actual outer wall diameter to determine construction requirements. Provide 22 gauge liner material for fittings with inner liner dimensions of 47 inches or less. Provide 20 gauge liner material for ducts with inner liner dimensions of 48 inches up to 84 inches.

#### 2.05 RECTANGULAR DOUBLE WALL DUCT FITTINGS

- A. Provide rectangular double wall inner and outer duct fitting gauges the same or greater than the rectangular straight duct thicknesses as indicated in these Specifications.
- B. Square throat 90 degree elbows to be provided with factory-installed, double-wall, hollow turning vanes in accordance with SMACNA recommendations. Rectangular elbows shall be centerline radius, 1.5 times duct width. Square throat mitered elbows are only to be used where shown on the drawings. The drawings shall indicate the style of elbow to be provided. Square throat 90 degree elbows shall include turning vanes. Square throat elbows that are less than 90 degrees shall not contain vanes.
  1. Turning vanes shall be double wall with every sixth vane welded to the runner. Provide standard vane spacing of 3.25" with a radius of 4.5". Different radius or spacing must be submitted for approval.
  2. Turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct.
  3. Turning vane front and back panels shall be securely locked together with adequate crimping to prevent twisting of vane. Vane shall be capable of withstanding 250 pounds of tensile load when secured according to the manufacturer's instructions.
  4. Rails for mounting turning vanes shall have self locking, friction fit tabs designed to facilitate proper alignment of vanes.

#### 2.06 ACOUSTICAL PERFORMANCE

- A. Minimum acoustical performance in dB per linear foot for straight sections of round and oval ductwork. Test section length for determining attenuation data is to be 24 linear feet.

MINIMUM ATTENUATION dB/ft.

DUCT DIAMETER OR MINOR AXIS	OCTAVE BAND					
	2	3	4	5	6	7
3"-6"	0.54	0.96	1.83	2.21	2.17	1.96
7"-9"	0.35	0.79	1.66	2.21	2.17	1.73
10"-12"	0.29	0.71	1.50	2.21	2.17	1.45
13"-18"	0.24	0.60	1.22	1.90	1.43	0.92
19"-24"	0.21	0.54	1.04	1.68	0.92	0.54
25"-30"	0.17	0.48	0.88	1.37	0.70	0.52
26"-36"	0.13	0.43	0.75	1.07	0.59	0.51
37"-48"	0.08	0.33	0.58	0.58	0.48	0.48
49"-58"	0.06	0.25	0.45	0.38	0.35	0.35

- B. All ducts shall be factory tested for attenuation in 24 foot sections. Provide certificate of performance with shop drawing submittal. Air flow velocity for the testing shall be 2,000 fpm.

2.07 DUCT NOISE ABSORPTION WRAP

- A. Where called for on the drawings, provide an acoustical absorption wrap around the ductwork to prevent breakout noise. The wrap shall be a flexible, mass loaded vinyl laminated to a quilted fiberglass decoupler on one or both sides. 2 inches thick, temperature rating of -20°F to 350°F. Vinaflex VP Noise Barrier or preapproved equal.

2.08 DUCT SEALS

- A. All duct transverse joints and longitudinal seams shall be sealed against a 10 inch static pressure and shall not exceed the leakage rate specified in other sections of this specification. Surfaces are to be clean and free from oil, dust, dirt, rust, moisture, or any substance which would interfere with bonding of sealant.
- B. Duct Sealant: Liquid seal for joints and seams. Surfaces are to be clean and free from oil, dust, dirt, rust, moisture, or any substance which would interfere with bonding of sealant. Where metal clearances exceed 1/16 inch, several applications are required.
1. McGill AirSeal Corporation "United Duct Sealer – Water Based"
  2. Hardcast "Duct-Seal 321"
  3. Ductmate "Proseal"

4. Products with documented VOC-emission rates meeting LEED guidelines by Dow Corning, Miracle Adhesives, Ductmate Industries, or Surebond, Inc.

- C. Provide soft elastomer butyl gaskets with adhesive backing to seal flanged joints.

## 2.09 FLEXIBLE CONNECTIONS

- A. Flexible duct connector shall be used where ductwork connects to fans of apparatus, or apparatus casing to fans to isolate vibration transfer. Connectors shall be attached in such a manner as to provide an airtight and waterproof seal. Connectors will comply with NFPA 90A, "Installation of Air Conditioning & Ventilation Systems" and NFPA 90B, "Installation of Warm Air Heating & Air Conditioning Systems."
- B. Indoor installations shall be of a UL 214 listed, fire retardant Vinyl coated woven nylon or Neoprene coated woven fiberglass fabric. Minimum density of Vinyl is 20 ounces per square yard and rated to 200 degrees F. Minimum density of Neoprene is 30 ounces per square yard and rated to 200 degrees F.
- C. Outdoor installations shall be of a UL 214 listed UV-resistant Hypalon coated woven-fiberglass fabric. Minimum density is 24 ounces per square yard and rated to 250 degrees F.

## 2.10 BLANK-OFF PANELS

- A. Provide 16 gauge, steel or aluminum, double skinned insulating blank-off panels behind louvers as indicated on the drawings. Material shall match louver material. Panel finish and color to match louver. Seal airtight.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. All duct installations and duct construction shall comply with all requirements of this specification and meet or exceed SMACNA standards and recommendations for construction and installation.
- B. Provide sweep elbows at all changes of direction supply and return ductwork. If mitered elbows must be used due to coordination, provide turning vanes in 90 degree elbows only.
- C. Seal all seams and joints.
- D. Provide a minimum 6 inch flexible connection where ductwork connects to motor driven equipment. Do not bulge or install on a bind.
- E. Provide duct access doors at all fire dampers, smoke dampers, combination fire/smoke dampers, and motor-operated control dampers. Provide ceiling access panel in drywall or other inaccessible ceiling systems such that all such dampers are serviceable.
- F. Keep ductwork tight to underside of structure. Maintain at least 7 inches clear between duct and ceiling construction.



- G. Install all dampers and provide blank-off plate to seal frames airtight.
- H. Provide volume dampers as needed to balance system to air flow indicated on the drawings.
- I. Provide duct access doors at all duct smoke detector locations. Coordinate locations with the Electrical Contractor.
- J. Galvanizing Repairs – Repair galvanizing damaged by welding, scratches, etc., using cold galvanizing compound.
- K. Branch taps off of elbows are prohibited.

### 3.02 TESTING

- A. Test Requirements:
  - 1. Installed ductwork shall be tested prior to installation of access doors, take-offs, etc.
  - 2. The Contractor shall give the Architect, Engineer, and Owner 72 hours notice prior to testing.
  - 3. Any testing conducted without prior notification shall be considered invalid and will be redone at the Contractor's expense.
  - 4. Leak-test all ductwork. Air leakage in any tested section of ductwork shall not exceed that of SMACNA Leakage Class 6.
- B. Recommended Test Procedure: Perform testing in accordance with SMACNA HVAC Air Duct Leakage Test Manual and as follows below. Note that this reference establishes procedures only; and the allowable leakage rates are found in these Specifications.
  - 1. Use a certified orifice tube and its corresponding logarithmic chart for measuring the leakage. Supply fan must have a CFM capacity greater than the allowable leakage in CFM for the section being tested.
  - 2. Define section of system to be tested and blank off.
  - 3. Determine the percentage of the system being tested, on a square foot of surface area basis.
  - 4. Using the percentage determined in Step "3" and the maximum allowable leakage of 2% of the total system volume, determine the allowable leakage (cfm) for the section being tested.
  - 5. Pressurize to 100% of the duct pressure class design pressure and repair any significant or audible leaks.
  - 6. Pressurize again and measure leakage.
  - 7. Repeat Steps "5" and "6" until the leakage measured is less than the allowable defined in Step "4."
- C. Document all duct testing and submit testing results as part of "As-Built" documents. Furnish copies of all completed duct testing documentation upon request of the Architect, Engineer, or Owner.

### 3.03 DUCT CLEAN OUT

- A. Clean and blow out complete duct system before any connections to equipment are made. Inspect ductwork for debris before starting any fans.

- B. Interior surfaces shall be free of dust and debris prior to initial start up. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning.
- C. When internally cleaning duct work prior to installation or shipment to the jobsite, cover all duct ends and openings with a dual polyethylene protective film. Securely affix the film to protect against dirt and debris. Film must be translucent to facilitate inspection of interior surfaces without removing film. Film must have a minimum elongation of 600%, contain no VOC and leave no residue on duct after removal. Ductmate Industries "ProGuard" or approved equal.
- D. Clean external surfaces of foreign substances that might cause corrosion, deterioration of the metal, or where ductwork is to be painted.

### 3.04 LEED / CLEANLINESS REQUIREMENTS

- A. Construction Indoor Air Quality:
  - 1. Follow control measures of SMACNA IAQ Guidelines for Occupied Buildings Under Construction, Chapter 3, latest edition and as described below.
  - 2. Protect stored on-site or installed absorptive materials from moisture damage.
  - 3. After fabrication in the shop, wipe down interior of each piece of supply air and return air ductwork with a lint-free rag, using a solution of 30% isopropyl alcohol and 70% water.
  - 4. Cap/seal supply, return, and exhaust air duct openings immediately after fabrication or cleaning. Schedule deliveries to the job site to match installation to avoid excessive storage at the job site. Store ductwork at the job site in closed trailers or in the immediate area in which it will be installed. Any ducts at the site that have any opening seals perforated are to be re-cleaned per shop cleaning requirements and re-sealed until needed for installation. Maintain caps/seals on all openings of installed ducts. If openings of installed ducts have their seals perforated, re-clean contaminated duct sections per shop cleaning requirements.
  - 5. Demonstrate the cleanliness quality control to the Construction Manager.

END OF SECTION

## SECTION 23 33 13 - DAMPERS

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Provide all dampers for adjusting and modulating airflow. See floor plans, schedules and details for required equipment for all specific situations.
- B. Scope of work includes the installation of all motor-operated control dampers, including those that may be furnished by the Temperature Control Contractor.

#### 1.02 QUALITY ASSURANCE

- A. Standards: AMCA Standard 500 Certified Performance.

#### 1.03 MANUFACTURERS

- A. Ruskin, Greenheck, Louvers and Dampers, Arrow/United, Vent Products, or American Warming and Ventilating.

### PART 2 PRODUCTS

#### 2.01 COUNTERBALANCED BACKDRAFT DAMPERS

- A. Steel frame, extruded aluminum blades with vinyl edge seal, 1/2 inch axle, dustproof ball bearings, adjustable counter-balance weights, weather-resistant construction.

#### 2.02 HIGH VELOCITY CONTROL DAMPERS

- A. Round, low leakage, butterfly, 18 gauge steel frame, two layer single steel blade, neoprene seal, 1/2 inch O.D. axle, stainless steel sleeve bearings, extended control shaft, rolled stiffener beads to seal with round spiral ductwork.
  - 1. Ruskin Type CDRS-25.

#### 2.03 INLET VANE DAMPER

- A. Round, 10 gauge steel frames, radial 16 gauge steel blades, open hub, 1/2 inch O.D. steel axle, stainless steel sleeve bearings, mounting frame. Vane shall be internally mounted.
  - 1. Ruskin Type IVD.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install all dampers in ductwork and provide access to adjustments as required.

- B. Coordinate the selection and installation of all motor-operated control dampers, including those that may be furnished by the Temperature Control Contractor.

3.02 CONTROLS

- A. See Section 23 09 23, "Temperature Control" for control requirements.
- B. Provide motor-operated dampers as required to execute the provisions described in Section 23 09 93, "Sequences of Operation."

END OF SECTION

SECTION 23 34 17 - FANS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Provide packaged, factory-wired fans as scheduled.
- B. Provide curbs, dampers, caps, duct filters, and other accessories as called for in the individual product sections.

1.02 QUALITY ASSURANCE

- A. Standards:
  - 1. AMCA 210: Fan performance rating.
  - 2. AMCA 300: Sound rating.
  - 3. U.L. Listed: Fan assembly.

1.03 RATINGS AND CAPACITIES

- A. Refer to the Drawings for CFM, static pressure, RPM, drive, sound ratings, voltage accessories, HP, and other electrical requirements.

1.04 SUBMITTALS

- A. Provide fan performance curves and dimensional drawings. Brake horsepower shall include drive losses. Data shall be provided with equipment submittal drawings.

PART 2 PRODUCTS

2.01 WALL PROPELLER FAN

- A. General Construction: One piece steel fan panel with spun venturi, formed flanges and welded corners, epoxy coated steel components, rigid drive support frame, pillow block sealed shaft ball bearings, steel shaft, belts, adjustable sheaves, adjustable motor slide base, totally enclosed motor, guard with removable section, and reversed drive for supply air application.
- B. Packaged wall propeller fan shall be furnished with aluminum shutter, steel or aluminum box including motor side guard. Provide an adjustable anchor angle, which adjusts to the thickness of the wall.
- C. Loren Cook, Greenheck, or Twin City.

2.02 INLINE CENTRIFUGAL FANS

- A. General Construction: Galvanized steel housing with baked enamel finish, complete with duct flanges, adjustable motor frame mounts, belt guard and integral support attachments.

- B. Fan Wheel: Non-overloading, backward-inclined centrifugal, statically and dynamically balanced, matched venturi inlet and wheel cones.
- C. Motor and Drive Assembly: Motors shall be single-speed, totally enclosed with sealed ball bearings. Unless noted otherwise, motor and drive assembly shall be AMCA Arrangement #9, motor position A. Drive assembly shall have adjustable cast iron sheave, sealed ball bearings, and belts sized minimum of 150% motor HP. Include extended bearing oilers. Direct drive units shall be provided with electronically commutated motors (ECM) with permanently lubricated ball bearings and motor-mounted speed control dial with motor pigtail leads for connection to 0-10VDC BMS speed control signal, allowing continuous adjustment between minimum and maximum motor speeds. Provide grounding rings for VFD applications.
- D. Controls: Factory-installed disconnect switch.
- E. Accessories: As scheduled.
- F. Loren Cook, Greenheck, Twin City, or Hartzell.EXECUTION

#### 2.03 INSTALLATION

- A. Secure units to building structure in accordance with the Drawings and the manufacturer's recommendations.
- B. Install flexible connections at inlet and outlet ducts.
- C. Mount fan as shown on the Drawings and install vibration isolators as required by Section 20 05 80, "Vibration Isolation." Provide auxiliary steel as required to support the fan.
- D. Furnish and install a second (if required) set of fixed sheaves and belts, as required for proper final balance of belt-drive units. Sheaves and belts to be selected by the Balancing Contractor.
- E. After units have been operating for 48 hours, all bearings shall be checked and tightened on shaft.
- F. Drive belts to be properly tensioned and aligned by a company qualified in this work. Submit report to the Engineer. Tensioning performed under supervision of the manufacturer's Representative. Tension at start-up and re-tension after one (1) week of operation.

END OF SECTION

## SECTION 23 34 18 - FAN ARRAY

### PART 1 GENERAL

#### 1.1. SUMMARY

- A. Fan Systems to be installed in an Air Handling Unit (AHU) shall include the following components:
  - a. Fan(s)
  - b. Quick Connect Box(es)
  - c. Control Panel
  - d. Bulkhead Wall
  - e. Wall Harnesses
  - f. Backflow Device

#### 1.2. DEFINITIONS

- A. AMCA Air Movements and Control Association
- B. CFM Cubic Feet per Minute
- C. FLA Full Load Amperage
- D. inWc Inches of Water Column
- E. ISO 1940-1 Mechanical Vibration – Balance quality requirement for rotors in a constant (rigid) state
- F. kAIC Kiloampere Interrupting Current
- G. MCA Minimum Circuit Ampacity
- H. MOCP Maximum Overcurrent Protection
- I. NEMA National Electric Manufacturers Association
- J. NEC National Electric Code
- K. QCB Quick Connect Box
- L. SCC Short Circuit Current
- M. UL 1995 UL Standard – Heating and Cooling Equipment
- N. UL 508A UL Standard – Industrial Control Panels
- O. UL 508C UL Standard – Power Conversion Equipment

#### 1.3. QUALITY ASSURANCE

- A. Each Fan System shall be ETL Listed to conform with the requirements of UL 1995.
- B. Each Control Panel shall be UL 508A Listed.
- C. Each Quick Connect Box shall be listed as a UL 508A Recognized Component.

- D. Each Fan System component shall undergo a full operational test. [1] Each fan shall be electrically tested by an automated test sequence to verify proper functionality of the input and output signals. [2] Each harness assembly shall undergo HiPot and continuity testing for power and control connections, respectively. [3] Each Quick Connect Box and Control Panel shall undergo a quality inspection of all component connections and be electrically tested by an automated test sequence to verify functionality.
- E. Each Fan shall be tested in accordance with applicable AMCA Publications 211 and 311 in an AMCA accredited laboratory and certified for air and sound performance.
- F. Each Fan shall have a minimum balance quality of G6.3 per ISO 1940-1.
- G. Manufacturer shall demonstrate a minimum of five (5) years documented experience in the manufacturing of fan systems.

#### 1.4. SUBMITTALS

- A. Performance Data shall include:
  - a. System Airflow (Total, Per Fan), CFM
  - b. System Static Pressure, inWc
  - c. System Fan Curves (Static Pressure vs Airflow, Input Power vs Airflow)
  - d. Fan Horsepower (Maximum, Input)
  - e. Blade Speed (Maximum, Operating)
  - f. System Efficiency
  - g. System Redundancy
- B. Electrical Data shall include:
  - a. Input Voltage, Frequency, and Phase
  - b. FLA
  - c. MCA (System, Per QCB)
  - d. MOCP
  - e. kAIC / SCC Rating
- C. Control Data shall include:
  - a. Control Package (Basic or Premium)
  - b. Control Panel Rating (Indoor or Outdoor)
- D. Sound Data
  - a. Free Inlet/Discharge Sound Power Level for Fan Inlet and Discharge for frequency bands of 63, 125, 250, 500, 1,000, 2,000, 4,000, and 8,000 Hz.
- E. Physical Data
  - a. Bulkhead Width and Height (Nominal)
  - b. System Weight (Estimated)
  - c. Fan Quantity
  - d. Fan Model



- e. Fan Weight
- f. Fan Blade Material
- g. Fan Blade Diameter
- h. QCB Location [Handing]
- i. Backflow Device
- j. Control Panel Dimensions
- k. Fan Dimensional Drawing
- l. Bulkhead Wall Layout and Dimensional Drawing

#### 1.5. AS-BUILT DRAWINGS

- A. Component Drawings shall depict each Fan System's component arrangement, including bulkhead wall panel and fan locations as well as the harness bundle routes of the power and control cables. Each component shall be labeled to indicate function and/or location.

#### 1.6. DELIVERY, STORAGE, and HANDLING

- A. Fan Systems shall be shipped as component kits, across a series of labeled pallets. Upon receipt, all pallets shall be accounted for and inspected for signs of damage or defect.
- B. Components shall be stored unopened, in a cool, dry, indoor space or under heavy covering to prevent damage or deterioration. Fans shall be stored with the motor facing upward.

#### 1.7. WARRANTY

- A. Manufacturer shall choose to repair, replace, or credit the value of a failed component found to be covered under warranty.  
Warranty period of 5 years.
- B. Manufacturer shall stock standard replacement or interchangeable parts such that warranty replacement assemblies shall be available for shipment within 48-72 hours. Standard replacement parts shall be defined as fan assemblies, Control Panels, Quick Connect Boxes, and bulkhead wall panels as offered through our standard product. This coverage shall not extend to Backdraft Dampers, Inlet Guards, or other order components not included in the standard product offering.

## PART 2 PRODUCTS

### 2.1. SUMMARY

- A. The following manufacturers are approved for use. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein: Part 1 - GENERAL: 1.1.A.a
  - a. Q-PAC Fan System 1
  - b. Greenheck
  - c. Fanwall Systems

### 2.2. FANS

- A. Fans shall be high performance direct drive, single inlet, [1] plenum fans with backwards inclined impeller or [2] axial fans with sickle-shaped/fluidic blades, with high efficiency welded-aluminum or high-performance composite material and galvanized, aluminum, or composite support frame.
- B. Fans shall be provided with pre-wired power and control harnesses of a standard length corresponding to the fan dimensions such that all fans are interchangeable within a system.
- C. Preinstalled fan harnessing shall terminate with plug and socket-style connections, requiring no manual wiring of the power and control cables between the fan motor and Quick Connect Box.
- D. Fans shall be rated in accordance with AMCA Sound and Air Performance without accessories by the original manufacturer.
- E. Fans shall be equipped with motor overload protection.
- F. Fans shall have a minimum balance quality level of G6.3 per ISO 21940-11.

### 2.3. CONTROL PANEL

- A. Standard features shall be:
  - a. Control Panel shall be designed for remote installation for practical accessibility.
  - b. Control Panel shall include an external disconnect.
  - c. Control Panel shall comply with UL 508A.
  - d. Control Panel shall include a 0-10 VDC input for fan speed.
  - e. Control Panel shall be configurable as NEMA 1 for indoor environments or NEMA 4 for outdoor environments.
  - f. Control Panel shall be configured with a kiloampere Interrupting Capacity of 100 kAIC.
  - g. Control Panel shall include a Hand-Off-Auto (HOA) Switch and Potentiometer

- B. Premium control packages shall include the following additional features:
  - a. Included Hand-Off-Auto (HOA) Switch shall have the ability to bypass the controller for manual control of the system fan speed.
  - b. Control Panel shall contain a BACnet-compatible controller capable of monitoring the system's airflow, power consumption, and individual fan status.
  - c. Controller shall be configurable for fan speed control via BACnet interface (MS/TP), 0-10 VDC, constant airflow, or constant duct static pressure (sensor to be field provided).
- C. Fan array system manufacturer to include control panel that includes all the standard and premium features listed above in Part A & B.

#### 2.4. QUICK CONNECT BOX

- A. QCB shall be UL 508A Recognized.
- B. QCB shall include overcurrent protection for each fan in the system.
- C. QCB shall include wiring terminations for the power and control wiring from each fan in the system prior to connection to the Control Panel.
- D. QCB wiring terminations shall be of plug and socket-style, requiring no manual wiring of the power and control cables between the fan motor and QCB.

#### 2.5. BULKHEAD WALL

- A. Bulkhead wall assembly shall be constructed of 14 Gauge G90 formed sheet metal panels.
- B. Bulkhead wall assembly shall contain cutaways consistent with the fan inlet cone and rivet nuts consistent with the mounting hole pattern of the fan plate.
- C. Sheet metal panels of the bulkhead wall shall be designed for easy field transport and assembly, able to fit through a 21" x 40" opening.
- D. Sheet metal panels shall be provided with pre-punched hole patterns matching adjacent panels and other applicable wall equipment for modular installation of supplemental components.
- E. Sheet metal panels shall have a bend profile providing structural support for the finished wall assembly.
- F. Sheet metal panels shall be provided with labels reflecting their installation order and relative location, as well as labels for any location-specific components.
- G. Sheet metal panels designed for fan installation shall include a sheet metal ledge per fan installation location designed to support the weight of the fan during installation.

2.6. BACKFLOW DEVICE: BLANK-OFF PLATE

- A. Fan systems having more than one (1) fan, and which do not include backdraft dampers shall be provided with one blank-off plate, which may be used in the case of failure of a single fan to replace the fan and prevent backflow through that location.
- B. Blank-off plates shall be constructed of 20 Gauge G90 sheet metal., matching the fan plate mounting hole pattern.

PART 3 EXECUTION

3.1. INSTALLATION

- A. System installation shall be in accordance with provided manufacturer's instructions and as indicated in supplemental materials.
- B. System shall be installed in the airstream with sufficient structural support for the perimeter angle of the bulkhead wall assembly or utilizing an existing flange having sufficient support for the wall panels directly.
- C. System installation shall be arranged for sufficient access area for service and maintenance.
- D. A qualified electrician shall mount the control panel and run all required connections to the Control Panel and between the Control Panel and QCB(s) in compliance with the NEC and applicable local codes.

3.2. FIELD QUALITY CONTROL

- A. [Optional] Manufacturer's Site Supervision: As an option, a factory-authorized service representative shall preform field supervision during installation and start-up to inspect the overall installation of the equipment, including electrical connections.
- B. After electrical circuitry has been energized, the system shall be field tested to confirm proper fan and unit operation.

END OF SECTION

SECTION 23 41 05 - FILTERS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Provide filters as shown on the Drawings. Refer to Schedules for type, size, efficiency, and other design requirements.
- B. Filters shall have a minimum efficiency MERV-A value when evaluated under the guidelines of ASHRAE Standard 52.2, including Appendix J of the same Standard.

1.02 QUALITY ASSURANCE

- A. Standards:
  - 1. ASHRAE 52.2
  - 2. MIL-STD-282
  - 3. UL 900

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Camfil or American Air Filter.

2.02 DISPOSABLE BAG FILTERS

- A. Filter media shall consist of high-density glass media that is chemically bonded to a synthetic micro mesh media support backing forming a lofted filter blanket. Pockets shall be formed into tapered pleats, supported by controlled media space stitching, to promote uniform airflow across the surface of the media. At any point, the sizes of the upstream and downstream passages shall be proportional to the volume of filtered air. Media shall be bonded to frame to prevent air bypass.
  - 1. Camfil Hi-Flo ES.
- B. Performance of the filter shall comply with the following minimum performance data based upon a 24" by 24" by 12" deep 8-pocket filter tested at 2000 cfm.

MINIMUM FILTER PERFORMANCE REQUIREMENTS

Efficiency	Initial Resistance (W.C.)	Media Area
MERV 9A	0.20"	58 sq. ft. based upon 24" by 24" by 12" size
MERV 11A	0.28"	58 sq. ft. based upon 24" by 24" by 12" size
MERV 13A	0.45"	58 sq. ft. based upon 24" by 24" by 12" size
MERV 14A	0.68"	58 sq. ft. based upon 24" by 24" by 12" size

- C. Filters shall be capable of withstanding 10 inches W.C. without failure of the media pack.

2.03 DIRTY FILTER GAUGE

- A. Provide a differential pressure gauge across the following filter banks:
  - 1. All air handler filter banks
- B. On air handler prefilter/main filter banks, provide valving and piping to allow reading to be taken across prefilter bank and main filter bank, both individually and collectively.
- C. Filter gauges shall be 4 inch diameter, 0 to 2 inch W.C. range, and an adjustable signal flag.
- D. Dwyer Series 2000 "Magnehelic," or approved equal.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

- A. Install filters and holding frame at locations indicated on the Drawings.
- B. Level filter assembly and provide service access.
- C. Tighten filters and achieve a 50% gasket crush to prevent air bypass.
- D. Install filter gauge across each filter bank, one (1) for each pre-filter and one (1) for each final filter.
- E. When operating fans during construction, filters are to be in place and replaced when pressure drop reaches 1 inch W.C. more than the initial resistance. Do not operate fans without filters.
- F. At the time of occupancy, install new media throughout for each piece of equipment requiring filters. Provide one (1) complete replacement set of filters for each piece of equipment upon completion of the project.

END OF SECTION

## SECTION 23 81 28 - VARIABLE REFRIGERANT FLOW AIR CONDITIONERS

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Provide a variable capacity heat pump (VRF) system consisting of outdoor heat pump units, air handler direct expansion coils, electronic expansion valve kits, BACNet interface, and capability of providing heating or cooling when given the appropriate controls signal from the BAS system. System shall be capable of operating in heating or cooling, independently of other outdoor systems. The system shall change mode of operation with no interruption to the system operation.
- B. The control system shall consist of a low voltage communication network of unitary controllers. Refer to Section 23 09 93, "Sequence of Operations" for controls integration.

#### 1.02 QUALITY ASSURANCE

- A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electric Code (NEC).
- C. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
- D. The outdoor units will be factory charged with R-410A.
- E. The system must be installed by factory-trained personnel employed by the Contractor. All bidders shall be required to submit training certification proof prior to installation. By submitting a bid, the Contractor acknowledges the installation price is based on the systems installation requirements and with complete knowledge of the HVAC system requirements.

#### 1.03 RATINGS AND CAPACITIES

- A. See Drawings for capacity requirements. Conditions for selection are 75 degrees F and 48.8% RH indoor, 92 degrees F outdoor for summer, and 70 degrees F indoor with 0 degrees F outdoor for winter.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendations.

#### 1.05 MANUFACTURERS

- A. Daikin, no alternate manufacturers are acceptable

1.06 WARRANTY

- A. Provide a 10 year parts and a 1 year labor warranty on the entire system, commencing at startup or 6 months from shipment, whichever occurs first. Labor warranty shall be provided by a factory-trained service professional.

PART 2 PRODUCTS

2.01 AIR HANDLER DIRECT EXPANSION COILS

- A. Direct expansion refrigerant cooling coil shall be provided. Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Coil connections must be sealed in the field by the installing contractor with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. Contractor must supply all coil connection grommets and sleeves.
- B. Sweat type copper suction headers shall be provided.
- C. Fins shall have a minimum thickness of 0.0075 inch aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.
- D. Coil tubes shall be 3/8 inch OD seamless copper, 0.016 inch nominal tube wall thickness, expanded into fins on 1 1/2-inch centers, brazed at joints.
- E. Sweat type copper suction connections located at the bottom of the suction headers for gravity oil drainage. Coils shall be uniformly circuited in a counterflow manner for fully interlaced capacity reduction as shown on unit schedule. Pressure type liquid distributors used. Coils shall be tested with 315 pounds air pressure under warm water, and suitable for 250 psig working pressure.
- F. Coil casing shall be a formed channel frame of stainless steel.

2.02 AHU VRV INTEGRATION CONTROLLER

- A. General:
  - 1. Daikin model EKEQFCBAV3-US control box shall be used to control the flow of R-410a refrigerant to the air handling units connected to a VRV condensing unit by means of a Daikin EKEXV500 expansion valve kit. Each EKEQFCBAV3-US control shall be paired with one EKEXV500 expansion valve kit. The EKEQFCBAV3-US shall control the refrigerant flow as determined by a 0-10VDC input provided by a field-supplied DDC controller
  - 2. The unit shall be furnished with 2 thermistors required for control of the expansion valve. These thermistors shall be field-installed in the air handling unit as required.



3. The unit shall be furnished with 9 capacity setting adaptors, each corresponding to an appropriate EKEXV500 capacity selection.
4. The unit shall be furnished with a conduit mounting plate and sealing gasket.
5. Unit Enclosure:
  - a. The unit enclosure shall be constructed of a polymer resin suitable for indoor or outdoor installation in accordance with UL1995.
  - b. The units shall be constructed such that when the cover is opened for electrical connections, the cover shall remain attached to the body of the control box.
6. Electrical:
  - a. 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.
  - b. Transmission (control) wiring between the EKEQFCBAV3-US and the VRV outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
  - c. The length of transmission (control) wiring between the EKEQFCBAV3-US and the field-supplied DDC controller shall be determined by the DDC manufacturer.
  - d. The length of transmission (power and control) wiring between the EKEQFCBAV3-US and the EKEXV500 shall be a maximum of 65 feet (20m).
  - e. All wiring shall be in accordance with National Electric Code (NEC)/Canadian Electrical Code (CEC) and any applicable local or regional codes.
7. Control:
  - a. The EKEQFCBAV3-US shall receive a 0-10V DC input from a field-supplied DDC controller.
  - b. The VRV outdoor unit shall adjust the system target evaporating temperature (in cooling mode) and target condensing temperature (in heating mode) in response to the 0-10V DC input.
  - c. The unit shall receive a 16V DC analog input from the included liquid pipe thermistor attached to the field supplied air handling unit. The thermistor shall be field-installed as necessary with the included 8.5 feet of wiring.
  - d. The unit shall receive a 16V DC analog input from the included gas pipe thermistor attached to the field supplied air handling unit. The thermistor shall be field-installed as necessary.
  - e. The unit shall be compatible with the Daikin BRC1E72, BRC1E73, and BRC2A71 indoor unit controllers for purposes of field-setting and troubleshooting purposes only. These controllers shall not be used for controlling refrigerant flow to the expansion valve.
  - f. The unit shall be capable of receiving a contact input On/Off signal.
  - g. The unit shall provide a 16V DC output to the EKEXV500 expansion valve. This output shall provide both power and communication/control to the expansion valve.
  - h. The unit shall provide a voltage-free contact signal output for use with the air handling unit fan operation. Additional fan speed control shall be via the DDC controller or other Building Management System control.
  - i. The unit shall provide a voltage-free contact signal output indicating compressor on/off operation.
  - j. The unit shall provide a voltage-free contact error signal output.
  - k. The unit shall provide a voltage-free contact signal output indicating the VRV outdoor unit is in a defrost cycle.
  - l. The VRT function for the VRV outdoor unit shall be automatically disabled upon connection of the EKEQFCBAV3-US.

- m. The unit shall be capable of wiring to the Daikin VRV D-III Net communication using the F1,F2 terminal block.
- 8. Optional Accessories:
  - a. The unit shall be compatible with the BRC1E72, the BRC1E73, and the BRC2A71 for field setting and troubleshooting purposes only.
  - b. The unit shall be compatible with the I-Touch Manager (DCM601A71).
  - c. The unit shall be compatible with the following expansion valve kits: EKEXV63-US, EKEXV80-US, EKEXV100-US, EKEXV125-US, EKEXV140-US, EKEXV200-US, EKEXV250-US, EKEXV400-US, EKEXV500-US.
  - d. The unit shall be compatible with DACA-KRCS-PW40 and DACA-KRCS-PW80 thermistor cables

2.03 AHU VRV INTEGRATION ELECTRONIC EXPANSION VALVE

A. General:

- 1. Daikin model EKEXV500 expansion valve kit shall be used to control the flow of R-410a refrigerant to a non-VRV air handling unit connected to a VRV condensing unit. Each EKEXV500 shall be paired with one EKEQFCBAV3-US control box. The EKEXV500 shall be compatible with R-410a refrigerant, and shall be capable of an expansion valve control resolution of 2000 pulses.

B. Performance:

- 1. The unit's performance shall be determined by the selected operating conditions, and shall fall within the following range:

Model Number	Nominal Capacity	Cooling Capacity (Btu/h)		Heating Capacity (Btu/h)	
		Min.	Max.	Min.	Max.
EKEXV50-US	18 MBh	17,500	21,000	19,000	24,000
EKEXV60-US	24 MBh	21,500	26,500	24,200	30,000
EKEXV80-US	30 MBh	27,000	34,500	30,500	38,000
EKEXV100-US	36 MBh	34,000	42,000	38,500	47,000
EKEXV125-US	48 MBh	42,500	52,500	47,500	59,000
EKEXV140-US	60 MBh	53,000	60,000	59,500	67,500
EKEXV200-US	72 MBh	60,500	84,000	68,000	94,500
EKEXV250-US	96 MBh	84,500	105,000	95,000	118,500
EKEXV400-US	144 MBh	120,000	169,000	136,000	187,500
EKEXV500-US	192 MBh	170,000	210,000	188,000	236,500

C. Unit Enclosure:

- 1. The unit enclosure shall be constructed of a heavy gauge sheet metal with a powder coat finish, and shall be suitable for both indoor and outdoor installation.

- D. Piping:
  - 1. All piping within the unit shall be copper.
  - 2. The unit shall be furnished with refrigerant filter/driers on both the inlet and outlet piping to the expansion valve.
  - 3. External refrigerant connections to the unit shall be brazed connections.
  - 4. Both refrigerant lines shall be fully insulated from the outdoor unit
  
- E. Electrical:
  - 1. The unit shall not require a dedicated power connection. Power to the expansion valve shall be provided via 12V DC input connection from the paired EKEQ\*CBAV3-US control box.
  - 2. The power wiring connection shall be made using the factory included 18 AWG wiring harness. The connection shall be capable of up to 65 ft (20m) of wiring length.
  
- F. Control:
  - 1. The control signal to the EKEXV500 shall be received via the factory included 18 AWG wiring harness. The connection shall be capable of up to 65 ft. (20m) of wiring length.
  
- G. Optional Accessories:
  - 1. The control signal to the EKEXV500 shall be received via the factory included 18 AWG wiring harness. The connection shall be capable of up to 65 ft. (20m) of wiring length.

#### 2.04 OUTDOOR UNIT

- A. Outdoor Unit: The outdoor unit shall be completely assembled, piped, wired, and tested at the factory. Provide galvanized steel frame that is finished with a powder coat, baked enamel finish. System shall have DC inverter-driven hermetic scroll compressor(s), and the unit shall operate with R-410a. All units requiring a factory supplied twinning kit shall be piped together in the field without the need for equalizing lines. This unit shall have an accumulator, high pressure safety switch, crankcase heater, high efficiency oil separator and over-current protection. The unit shall be capable of operating in the heating mode with ambient temperatures down to -4 degrees F. Provide vertical discharge, variable speed, direct drive fans with permanently lubricated bearings, and a condensing coil that is of non-ferrous construction with louvered fins on copper tubing.
  
- B. The unit sound rating shall be no higher than 60 dBA individually and 64 dBA if twinned. Coil shall be corrugated plate fins on copper tubing. Coils shall have integral metal guard. Unit shall have at least one inverter driven scroll compressor with internal thermal overload.
  
- C. Control System: Provide a central controller for the system that can control all of the indoor units and the outdoor unit. This controller will initiate the mode change from heating to cooling, and it can lock out the system or individual units. Provide a building network unit interface to communicate between the central controller and the Building Automation System via a BACNet interface. This will allow the system to be accessed through the Web, and it will provide status reports for functions such as operation mode, fan speed, errors, airflow, and set temperature.

## 2.05 CONTROLS

- A. Provide a complete electronic control system interconnecting all components of the system.
- B. Control system shall interface with the BAS via BACNet read/write level control of all components. Refer to the Sequence of Operations section for interface requirements between the manufacturer control system and the BAS.
- C. Provide access to all data needed for building maintenance. Provide one unit of each tool required for service and start-up. Provide Owner training for each device.
- D. Refrigerant leak alarm shall be sent to the BAS.
- E. Provide hardware and software necessary to monitor and report system energy use to the BAS.

## 2.06 PIPING

- A. Provide hard drawn, Type "L" copper piping (ASTM B88) from the outdoor unit to the expansion valve. Fittings shall be wrought copper or bronze with brazed joints.
- B. Provide soft copper line sets from the expansion valve to the DX coil.

## PART 3 EXECUTION

### 3.01 INSTALLATION TRAINING (FACTORY)

- A. Provide factory training for four individuals from Owner. Training shall include installation and controls.
- B. Install unit and piping as per manufacturer's written recommendations.
- C. Make wiring connections between remote room control and unit mounted control devices and panel. Make any other field wiring connection required for remote or duct mounted sensors.
- D. Make all refrigerant-piping connections, fully charge unit, and complete installation in accordance with the manufacturer's written installation instructions.
- E. Outdoor unit shall be installed on 18 inch high rails, coordinate with roof drain locations and proper roof drainage.
- F. All refrigerant lines between the outdoor unit and the DX coil shall be insulated.
- G. The system start-up shall be by manufacturer trained and certified personnel.

3.02 Manufacturer's Field Service:

- A. Engage VRV HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installation
- B. Manufacturer Support
  - 1. Manufacturer shall provide on-site visits during construction at installation milestones indicated. System Installer shall coordinate each visit in advance to give manufacturer enough notice to plan the visit. Installation, including controls and connections.
    - a. First Visit: Kick-off meeting with installing Contractor and controls contractor.
    - b. Second Visit: At approximately 25 percent completion of system(s).
    - c. Third Visit: At approximately 50 percent completion of system(s).
    - d. Fourth Visit: At approximately 75 percent completion of system(s).
    - e. Fifth Visit: Final inspection before system startup.
- C. Refrigerant Tubing Positive Pressure Testing:
  - 1. After completion of tubing installation, pressurize tubing systems to a test pressure of 550 psig unless M# FXTQ the max pressure of 450 psig, using dry nitrogen. Pressure to hold 24 hours with time stamped photos or witnessed by General contractor or Factory Representative
- D. Refrigerant Tubing Evacuation Testing:
  - 1. Good refrigerant practices should be followed by using triple evacuation method
    - a. Evacuate down to 4000 microns holding for 15 mins
      - i. Break with Dry Nitrogen to 2-3 PSIG system pressure
    - b. Evacuate down to 1,500 Microns holding for 20 mins
      - ii. Break with Dry Nitrogen
    - c. Evacuate down to 500 microns or less holding for 1 hour without rise
      - iii. Manufacture Rep Verification of Evacuation test.
  - 2. System charged with manufactures calculated charge after actual pipe lengths measured once installed.
- E. System Start up and Operation Report:
  - 1. After completion of startup service, manufacturer shall issue a report for each separate system.
  - 2. Manufacturer shall electronically record not less than 1 hours of operation
- F. MAINTENANCE SERVICE
  - 1. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by persons who are manufacturer's authorized service representatives. 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.

G. SOFTWARE SERVICE AGREEMENT

1. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years. Continuous operation of each system and submit with report for historical reference.
2. 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.

H. Manufactures Warranty Period

1. For Compressor: 10 years from date of Substantial Completion.
2. For Parts, Including Controls: 10 years from date of Substantial Completion.
3. For Labor: 5 years from date of Substantial Completion.

END OF SECTION

SECTION 23 82 39 - UNIT HEATERS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Provide unit heaters, complete with coil, filters, fans, and controls.

1.02 QUALITY ASSURANCE

- A. Standards: Underwriters' Laboratories (UL) label.

1.03 RATINGS AND CAPACITIES

- A. Refer to the Drawings for type and arrangements, MBH, CFM, GPM, voltage, HP, and other design requirements.

1.04 MANUFACTURERS

- A. Hot Water or Steam Units: Dunham-Bush, Rittling, Airtherm, Sterling, Modine, or Trane.

PART 2 PRODUCTS

2.01 PROPELLER UNIT HEATERS

- A. General Construction:
  - 1. Horizontal Projection Units: Stamped steel case, phosphatized and finished with baked enamel, complete with full back plate for resilient fan mounting with guard, venturi air inlet, double-deflection adjustable louvers, and weld nuts for hanger rod supports.
- B. Heating Element:
  - 1. Hot Water Coil: Serpentine design, seamless copper tubing with mechanically bonded aluminum fins, air tested to 300 psig under water.
- C. Fan: Balanced propeller type, aluminum blades, shaft-mounted to totally enclosed motor with thermal overload protection and Class "B" insulation.
- D. Controls: 24 volt, including control transformer, fan motor starter, fan speed switch unit mounted, and thermostat.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units as per the Drawings and/or the manufacturer's recommendations. Use flexible connections at inlet and discharge ductwork, if applicable.

- B. Mount propeller units at 8 feet minimum height to the bottom of unit unless otherwise noted.
- C. Install thermostats. Provide all field-installed control and interlock wiring.
- D. Filters shall be installed prior to operating the unit fans.
- E. At final completion, replace all filters with clean, new filters, and turn one complete set of replacement filters over to the Owner.
- F. For gas-fired units, install flue according to the manufacturer's instructions.

END OF SECTION



SECTION 26 00 00 - DIVISION 26 - ELECTRICAL INTRODUCTORY STATEMENT

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. The requirements of Instructions to Bidders, General Conditions, and Division 1 apply to all work herein.
- B. In addition to conforming to the documents listed in Paragraph 1.01 A. above, the Work performed by the Division 26 Contractor shall conform to all provisions of Sections 26 00 00 through 26 99 99 as included in this Specification. The Division 26 Contractor is to consider the word "Contractor" when used in these Sections to mean himself/herself.
- C. The Division 26 Contractor must read the Specifications of all divisions therein because they will be responsible for Work described in other Sections where reference is made to "Electrical Contractor."
- D. All work included under this heading is subject to the Bidding Requirements, General Conditions and Division 1 General Requirements written for this entire Specification, whether attached to this Part or not, and the Contractor is notified to refer thereto as an integral part of the Work.

1.02 APPLICABLE SECTIONS

- A. Contractor shall perform Work described in the preceding paragraphs, the General Conditions, Division 1 and in the following Sections (as included):

Electrical: Sections 26 00 00 through 26 99 99

- B. Contractor is required to coordinate his/her work with that described in other Sections, and therefore, must familiarize themselves with the entire set of Specifications.

1.03 RESPONSIBILITY

- A. The Engineer's efforts under this Contract are aimed at designing a project which will be safe after full completion. The Engineer has no expertise in, and takes no responsibility for, construction means and methods or job site safety during construction, which are exclusively the Contractor's responsibility. Processing and/or approving submittals made by the Contractor which may contain information related to construction methods or safety issues, or participation in meetings where such issues might be discussed must not be construed as voluntary assumption by the Engineer of any responsibility for safety procedures.

END OF SECTION

## SECTION 26 00 05 - DIVISION 26 GENERAL REQUIREMENTS

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Furnish all materials, labor, tools and equipment to complete and leave ready for operation all electrical systems as called for in these Specifications or shown on the Drawings and any and all details essential to complete the work.
- B. By submitting a bid, the Contractor certifies that:
  - 1. He/she has visited the site and is satisfied that he/she understands all site conditions that may have an effect on his/her bid price.
  - 2. He/she fully understands the makeup, construction, and operation of all systems and equipment he/she is bidding on, and that he/she has included in his/her price all materials, supplies, accessories, and services necessary to make these systems complete and operational.

#### 1.02 REFERENCE

- A. These General Requirements are in addition to the other requirements referenced in Section 26 00 00, "Introductory Division 26 Statement." They are not meant to replace them. In case of conflict, ask the Architect for interpretation.
- B. The Contractor is responsible for becoming thoroughly familiar with all Drawings and Specifications prior to bidding so that all conditions of work are clear with regard to electrical requirements of equipment, mounting conditions, etc. Contractor shall study reflected ceiling plans, elevations, and details, etc.
- C. The Division 26 Contractor is responsible for all electrical work shown, whether noted by his/her division or not, on all Drawings and Specifications in the entire construction documents package. In case of conflict, Contractor shall include greatest quantity of equipment, extent of work, and expense in his/her bid. If there is any question about scope, the bidder must bring his concerns to the attention of the Owner's representative during bidding.

#### 1.03 STANDARDS OF QUALITY

- A. Provide quality work conforming to the best accepted practices and standards of the trade. Further definition of quality is given by reference to various laws, codes, standards, and regulations. Refer also to the publications of NECA (National Electrical Contractors Association).
- B. All laws and codes having jurisdiction over this project are deemed to be included in their entirety as a part of these Specifications. Also, any other laws, codes, standards, or regulations referenced herein are deemed to be included in their entirety.

- C. If a conflict occurs between the Drawings and the Specifications, immediately call the conflict to the attention of the Architect at least ten (10) days before bids are submitted, so an addendum clarification may be issued. Conflicts not brought to the Architect's attention before bids are due, shall be priced by the Contractor to include the most expensive, highest quality and quantity of the conflicting items in question.
- D. Material and equipment installed under this Contract shall be new, undeteriorated, and of a quality not less than the minimum specified. All equipment and conductors shall be certified, listed and labeled by UL. If UL does not certify an associated piece of equipment, then certification by another nationally recognized testing laboratory such as ETL shall be permissible. If equipment or conductors are of a type that no testing lab lists or labels, then a safety evaluation must be performed at the supplier's expense by the inspecting authority or another Federal, State or municipal agency.
- E. The latest adopted editions of the following also apply to this work:
  - 1. National Electrical Code, NEC
  - 2. National Fire Protection Association Publications, NFPA
  - 3. State Building Codes
  - 4. City Codes
  - 5. Americans with Disabilities Act (ADA)

#### 1.04 CONTRACT DRAWINGS

- A. Drawings are schematic and show approximate locations and the extent of work. Exact locations and extent must be coordinated with other Contractors and verified in the field. Coordination of the final fabrication drawings and final coordination of the installation in the field is the Contractor's responsibility. Contractor is to take the design to the next level of detail knowing exactly what equipment and materials he/she is going to provide and build the project based on that equipment and other approved shop drawings.
- B. Significant deviations from Drawings must be approved by the Architect.
- C. The Architect reserves the right to make minor changes in location which do not require additional labor or material up to the time of roughing-in without additional cost. No cost shall be added to the Contract for a minor change. The Architect shall determine what is "SIGNIFICANT" and what is a "MINOR" change.

#### 1.05 DEFINITIONS

- A. "Provide": To furnish and install.
- B. "Concealed": Embedded in or installed behind walls and floors, within partitions, above suspended ceilings, or below grade.
- C. "Exposed": Not installed underground or "concealed" as defined above.
- D. "Contractor": Means the Division 26 Contractor.
- E. "Furnish": To purchase and deliver products to the project site and make ready for installation.

- F. "Install": To take furnished products, assemble, erect, secure, connect, and place into operation.
- G. "Products": Includes materials, systems and equipment.
- H. "Work": The providing of products for entire Contract.

#### 1.06 PERMITS, FEES AND NOTICES

- A. Unless otherwise excluded in the Contract Documents, secure and pay for all permits and governmental fees, licenses, and inspections necessary for the proper execution and completion of work.
- B. Give notice and comply with all laws, ordinances, rules, regulations and lawful orders of any public authority having jurisdiction on the performance of the work.

#### 1.07 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 required 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.

#### 1.08 ABBREVIATIONS

- A. Abbreviations used in these specifications:
  - ADA - Americans with Disabilities Act
  - ANSI - American National Standards Institute
  - CBM - Certified Ballast Manufacturers
  - EIA - Electronic Industries Association
  - ETL - Electrical Testing Laboratories
  - FCC - Federal Communications Commission
  - ICEA - Insulated Cable Engineers Association
  - IEC - International Electro Technical Commission
  - IES - Illuminating Engineering Society
  - ITL - Independent Testing Laboratories
  - NEC - National Electrical Code
  - NECA - National Electrical Contractors Association
  - NEMA - National Electrical Manufacturers Association
  - NESC - National Electrical Safety Code
  - UL - Underwriters Laboratories

## PART 2 PRODUCTS

### 2.01 DESIGN BASE MANUFACTURERS ("STANDARDS")

- A. The Contract Documents are based on the requirements and layout of the equipment of the Design Base Manufacturer. Coordination of equipment with the building and with other trades has been made for these specific models and manufacturers of equipment. Where several manufacturers are listed, the first named is the Design Base Manufacturer, unless specifically noted otherwise. Products of the other listed manufacturers which are of comparable performance and quality to the Design Base Manufacturers may be submitted for review and approval per Section 26 00 15, "Submittals." Refer to 26 00 05, "Division 26 General Requirements," Paragraph 2.02, "Approved Equals" for products of manufacturers not listed.
- B. Prepare new layouts for all non-Design Base Manufacturers equipment and adjust and coordinate these layouts with equipment dimensions or service requirements which may be different from those of the Design Base Manufacturer. Verify that this equipment will fit and function in the indicated application. Submit these layouts as part of the submittal review.
- C. 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/her 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/her 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 Architect for approval. The Contractor shall investigate potential conflicts such as the following:
  - 1. 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 ratings for conductors, overcurrent protective devices, and motor control equipment
  - 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 overcurrent protective device characteristics

### 2.02 APPROVED EQUALS (EQUIVALENT) PRODUCTS

- 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 Architect for consideration and possible inclusion into the bidding documents. Submission must be received no later than ten (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 Architect. 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 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.
  
- C. Failure to comply with and provide all of the above requirements will result in the submission not being reviewed.

#### 2.03 QUANTITIES

- A. Equipment may be referred to either in these Specifications or on the Drawings, as singular or plural; Contractor is responsible for verifying the exact number of items required to complete his/her work.

#### 2.04 OWNER FURNISHED (CONTRACTOR INSTALLED) EQUIPMENT

- A. Certain items of equipment may be furnished by the Owner to the Contractor. The Contractor shall take delivery of such items and unload them from the truck at the job site.
- B. The Contractor shall protect and store such items as part of this Contract.
- C. The Contractor shall install these items in conformance with the requirements of the Specifications and Drawings and the supplier's recommended installation instructions.

#### 2.05 ACCESS DOORS

- A. Install junction boxes, remote ballasts, power supplies, etc. in locations where they will be accessible. Where not possible, Division 26 Contractor shall pay General Contractor to install access doors for electrical equipment. Coordinate all access door types and locations with the Architect. Remote ballasts and power supplies shall be located in a ventilated space.

#### 2.06 RECORD (AS-BUILT) DRAWINGS

- A. Contractor shall maintain at the job site, one (1) copy of Drawings which shall be used exclusively for recording the location of all installed work; not extraneous information such as field notes. Neatly record all information with red pen.

- B. Record deviations in locations of concealed conduit, equipment, lighting, outlets, manholes, etc., dimensioned from a fixed control point, including depth of bury, at each change of direction, at each change of slope and as required for further reference. Minor variations need not be recorded. Addendums, Change Orders, Field Work Orders, Supplemental Instructions and other pertinent changes of record shall be recorded. These changes shall be reviewed monthly for conformance.
- C. Record deviations made necessary to incorporate equipment different from the Design Base equipment.
- D. At completion of the project, Contractor shall deliver "As-Built" Drawings and Coordination Drawings to the Architect for review and approval with regard to completeness. This submission shall consist of the job site "As-Built" Drawings in electronic format and as PDF files. Following approval, provide a full-plotted set as well as the electronic version and original.
- E. Refer to Division 1 for additional requirements.

### PART 3 EXECUTION

#### 3.01 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 be done by a qualified tradesman skilled in the craft, and shall meet the requirements of Division 9. Each Contractor is responsible for repainting of finished areas disturbed by his/her 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.

#### 3.02 CUTTING AND PATCHING

- A. Unless otherwise required in General or Special Conditions, Contractor shall perform all cutting and patching required for his/her own work. Work must be accomplished in a neat and workmanlike manner, acceptable to the Architect.
- 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 of structural support beams, joists, plates, or other structural members is strictly prohibited without the specific written consent of the Architect. Use rotary drills where cutting holes through concrete, brick, plaster, or tile is necessary. Obtain approval of the Architect before proceeding with work.

- D. 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.
- E. Patching shall match adjacent materials and shall be accomplished only by tradesmen skilled in the respective craft required. Materials and equipment used in the patching work shall comply with requirements of those Sections of the Specifications relating to material to be used in new construction.

### 3.03 SCAFFOLDING, RIGGING, HOISTS AND TRANSPORTATION

- A. The Contractor shall provide scaffolding, staging, cribbing, tackle, hoists, and rigging necessary for placing of his/her materials and equipment in their proper places in the project.
- B. The Contractor shall pay costs for transportation of materials and equipment to the jobsite and shall include such costs in his/her proposal.
- C. Scaffolding and hoisting equipment shall comply with requirements of applicable Federal, State, and Local Laws and Codes.

### 3.04 CLEANING

- A. Upon completion of work, all material and equipment furnished in this Contract shall be thoroughly cleaned of labels, dirt, grease, rust, oil and other foreign matter. Prepare for finish painting, where painting is specified.

### 3.05 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 Architect (and Owner's representative) must be notified of all scheduled tests and adjustments at least 72 hours before they are scheduled so that he/she may witness same. Obtain confirmation of attendance or absence for each test. If the Contractor performs any test or adjustment without the Architect present, or without proper notification, the Contractor may be required to perform the test or adjustment a second time. All test schedules are to be coordinated with the Owner to minimize inconvenience.
- C. The Contractor shall bear all costs of such inspections, tests, or approvals.
- D. Required certifications of inspection, testing, or approval shall be secured by the Contractor and included in the Record and Information Manuals. See Section 26 00 20, "Record and Information Manuals."



3.06 WARRANTY OF WORK

- A. The Contractor shall warrant all work for a period of one (1) year from date of Contract Completion against defects in materials, equipment, and workmanship. All manufacturer warranties shall begin on date of Contract Completion also.
- B. The Contractor will be required to make all repairs or changes which, in the opinion of the Owner, are necessary as the result of defective materials, equipment, or workmanship.
- C. The Contractor shall, promptly upon receipt of notice from the Owner, and without expense to the Owner, replace all defective work with suitable materials and equipment.
- D. Failure by the Contractor to promptly respond to warranty service calls can be sufficient reason for the Owner to have the defects corrected at the expense of the Contractor.
- E. Refer to Division 1 for additional guarantee requirements.
- F. Refer to other Specification Sections for extended warranty requirements.

END OF SECTION

SECTION 26 00 10 - COORDINATION BETWEEN TRADES

PART 1 GENERAL

1.01 DESCRIPTION

- A. The Division 21, 22, 23, 26, 27 and 28 Contractors shall coordinate their rough-in, service, and control requirements with each other. Division 26 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.).
- B. Division 26 Contractor shall coordinate all of his/her work with the General Trades Contractor for location of all devices, luminaires and equipment prior to rough-in.
- C. All wiring required to power Division 21, 22, 23, 27 and 28 equipment shall be installed by the Division 26 Contractor, including 120 volt to temperature control panels. The Division 26 Contractor shall be responsible for all wiring from the fire alarm control panel.
- D. If motors and/or equipment are furnished by other divisions, which require larger or smaller starters, safety switches, circuit breakers, fuses, and/or branch circuit conductors than indicated, the Contractor furnishing the motors or equipment shall reimburse the Division 26 Contractor for any cost differential of providing different sized equipment.
- E. All electrical devices furnished as a part of Division 21, 22, 23, 27 and 28 equipment, and installation requirements of all electrical work done by Division 21, 22, 23, 27 and 28 Contractors shall conform to the applicable sections of Division 26.
- F. Division 26 Contractor shall coordinate with other Contractors prior to installation of switchboards and panelboards to ensure requirements of NEC Article 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.
- G. Final operation of equipment provided under Division 21, 22, 23, 27 and 28 shall be the responsibility of the respective Division 21, 22 or 23 Contractor.
- H. Division 26 Contractor shall coordinate in particular with Divisions 8, 10, 11, 12, 13, and 14 Contractors for specific requirements for door hardware, kitchen equipment, elevators, pool, theatrical equipment, window shades, etc.
- I. Division 26 Contractor shall provide an appropriate safety switch for all mechanical equipment that he/she is providing power for, unless furnished with equipment.
- J. Division 26 Contractor is responsible for all electrical work shown on all documents within the bid set.

END OF SECTION

## SECTION 26 00 15 - SUBMITTALS

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Refer to the GENERAL CONDITIONS and Division 1 for general requirements.
- B. Materials and equipment installed in this work shall meet all the requirements of the Contract Documents and no materials or equipment shall be ordered until submittals are reviewed and approved by the Architect and Engineer.
- C. Submit complete catalog data or shop drawings for each manufactured item of equipment and all components to be used in the work, including specific performance data, material description, rating, capacity, working pressure, dimensional data, material gauge or thickness, wiring diagrams, brand name, catalog number, and general type.
- D. Catalog data for equipment reviewed by the Engineer shall not take precedence over the requirements of the Contract Documents. The review of the Engineer shall not relieve the Contractor from the responsibility for deviations from Drawings or Specifications, nor from the responsibility for providing proper clearance and coordination with other Trades.
- E. When submitted for review, all shop drawings shall bear the Contractor's signed certification that he/she has reviewed, checked, and approved the shop drawings, that they have been coordinated with the requirements of the project and with the provisions of the Contract Documents, and that he/she has verified all field measurements and construction criteria, materials, catalog numbers, and similar data. Annotations shall be in red ink.
- F. Each required Specification Section submittal shall be complete with all required information included in one PDF file. External web links are not permitted. Include a transmittal cover page indicating Specification Section name and number.
- G. Each section shall be submitted separately for each section. Combining sections will result in revise and resubmit with no review.
- H. Submittals shall be sent to [shopdrawings@korda.com](mailto:shopdrawings@korda.com).

#### 1.02 CONTRACTOR'S RESPONSIBILITIES

- A. Complete review of shop drawings, product data, and samples prior to submission.
- B. Determine and verify:
  - 1. Field Measurements
  - 2. Field Construction Criteria
  - 3. Catalog Numbers and Similar Data
  - 4. Conformance with Specifications
- C. Coordinate each submittal with requirements of the work and the Contract Documents.

- D. Include a letter in the front of the submittal of any deviations in the submittals from the requirements of the Contract Documents.
- E. Make submittals and resubmittals, if necessary, promptly in accordance with the approved schedule and in such sequence as to cause no delay in the work or in the work of any other Contractor, or the project as a whole.
- F. Make any corrections or changes in rejected submittals as required by the Architect and resubmit until approved.
- G. Begin no fabrication or work which requires submittals until approved submittals are returned.

#### 1.03 INCORPORATION OF SUBMITTALS INTO RECORD AND INFORMATION MANUALS

- A. Refer to Section 26 00 20, "Record and Information Manuals."

#### 1.04 CERTIFICATIONS

- A. Provide:
  - 1. Test Agency results verifying capacities, operating conditions and power requirements at design conditions
  - 2. Manufacturer's Statement of Compliance with Standards discussed in individual Specification Sections
  - 3. Equipment labels indicating Certification requirements
  - 4. Quality standard designations on each unit piece
  - 5. Typed verification that noted mixes, chemical compositions, and testing procedures were complied with
  - 6. Other Certifications listed in other Sections of the Specifications

#### 1.05 REQUIRED SUBMITTAL INFORMATION

- A. Submittal Transmittal
  - 1. Provide the following information on the Transmittal Form for each submittal:
    - a. Project name and address.
    - b. Specification number, as listed for each submittal item required in Paragraph 1.05C below.
    - c. Item description, as listed for each submittal item required in Paragraph 1.05C below. Where equipment is identified by number or tag on the documents, same shall be indicated on the submittal.
    - d. Specification number and item description (b and c, above) for each submittal if more than one submittal is sent under one transmittal form.
    - e. Name, address and telephone number of Contractor.
    - f. Bid package number (if applicable).
  - 2. Submittal Transmittal Forms not properly identified with the above information will be returned (without review) to the Contractor.

- B. Refer to the following letter key:

KEY FOR REQUIRED SUBMITTALS:

- A. Shop Drawings and/or Layout Drawings
- B. Product Data Sheets
- C. Color Samples
- D. Product Samples
- E. Typed Statement
- F. Typed Verification of Compliance with Certification Requirements
- G. Motor Efficiencies and Power Factor
- H. Wiring Diagrams
- I. Installation, Operation, and Maintenance Instructions
- J. Reports or Test results

- C. Submit information on equipment items as listed below.

SECTION #	CONTRACT ITEM	SUBMITTALS REQUIRED
26 00 20	RECORD AND INFORMATION MANUALS	A, B, E, F, H, I
26 08 40	ELECTRICAL TESTS, ADJUSTMENTS, INSPECTIONS	J
26 22 13	DRY TYPE TRANSFORMERS	B, I
26 24 20	PANELBOARDS	B, I
26 27 26	WIRING DEVICES AND PLATES	B
26 28 13	FUSES	B
26 28 16	SAFETY SWITCHES	B, I
26 28 19	CIRCUIT BREAKERS	B, I
26 29 13	MOTOR CONTROLLERS	B, H, I
26 43 13	TRANSIENT VOLTAGE SURGE SUPPRESSION	B, I
26 81 11	FIRE ALARM SYSTEM	A, B, H, I

- D. After approval, one (1) copy shall be returned to the Contractor. Contractor shall make prints of the approved transparencies and reproductions of all other shop drawing information as necessary for his/her use and for inclusion in the Record and Information Manuals.

END OF SECTION

## SECTION 26 00 20 - RECORD AND INFORMATION MANUALS

### PART 1 GENERAL

#### 1.01 RECORD DRAWINGS

- A. Refer to Division 1 for general requirements as well as for specific information regarding Record (As-Built) Drawings. All drawings shall be provided in electronic PDF format.

#### 1.02 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 1 for general requirements and for specific information regarding Operation and Maintenance Manuals, including required format(s) (paper and/or electronic) and quantity. If no such requirements are listed in Division 1, provide in electronic format. Submit one (1) copy of draft manual to the Architect for review and approval thirty (30) days before final inspection is due. After approval, submit three (3) approved manuals to the Owner and obtain receipt. (See Section 26 00 99, "Requirements for Contract Completion.")
- B. Paper Copy Manuals shall be loose leaf, three-ring, heavy-duty hard-cover binders. Material shall be typewritten or printed and be fully legible. Each section shall be divided by labeled tabs.
- C. Electronic Copy Manuals shall be PDF file format. Individual documents shall have filenames corresponding to specification sections and system names. Each document shall have bookmarks corresponding to the systems, subsystems, and equipment names. Use electronic files prepared by manufacturers where available.
- D. The following items, together with any other necessary pertinent data, shall be included in each Manual:
  - 1. Each manual shall be labeled on front cover with project name, Contract, Contractor's name, Architect, Engineer, and date of project completion.
  - 2. Manufacturers' names, nearest Factory Representative, and model and serial numbers of components of systems
  - 3. Operating instructions, start-up and shutdown procedures
  - 4. Maintenance instructions
  - 5. Routine and 24 hour emergency service/repair information:
    - a. Name, address, and telephone number of servicing agency
    - b. Names of personnel to be contacted for service arrangements
  - 6. Parts list with numbers of replaceable items, including sources of supply
  - 7. Manufacturers' literature describing each piece of equipment
  - 8. One (1) approved copy of each submittal
  - 9. Written warranties
  - 10. Certificate of Material Receipt and Certificate of System Completion
  - 11. One (1) typewritten directory for each panelboard as installed
  - 12. Record (As-Built) Drawings
  - 13. Certificate of Final Inspection signed by Building Authority Having Jurisdiction

14. Test results
15. Coordination analysis (see Section 26 00 80, "Power System Coordination Analysis")
16. Video recordings of all equipment demonstrations and training sessions

END OF SECTION

SECTION 26 00 55 - SLEEVES, SEALS, AND FIRESTOPS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish and install sleeves for conduit penetrations through masonry and concrete construction or where conduit passes through walls exposed and through smoke or fire rated separations.
- B. Provide watertight, and fire rated seals and firestopping as specified herein.

1.02 QUALITY ASSURANCE

- A. Firestopping materials shall be classified by UL as "fill, void or cavity materials" and "through penetration firestop systems."
- B. Firestopping materials shall conform to both Flame (F) and Temperature (T) ratings as tested by nationally accepted test agencies per ASTM E-814 or UL 1479 Fire Tests of Through-Penetration Firestops.
  - 1. The F rating shall be a minimum of one (1) hour, but not less than the fire resistance rating of the assembly being penetrated.
  - 2. Conduct the fire test with a minimum positive pressure differential of 0.01 inches of water column.
- C. Firestopping equipment used shall be in accordance with the Manufacturer's written installation instructions.
- D. Firestopping materials shall be expanded to fill cavities or provide adhesion to substrates that will maintain seal under normal expected movements of substrates.

1.03 SUBMITTALS

- A. For Review:
  - 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
- B. To be included in Record and Information Manuals:
  - 1. One (1) copy of each approved submittal



#### 1.04 MANUFACTURERS

Subject to compliance with requirements, provide products by one of the following:

- A. Seals
  - 1. Link-Seal by Thunderline Corporation
  - 2. CSD Sealing Systems
  - 3. O-Z/Gedney Inc.
  
- B. Firestopping Materials
  - 1. Hilti
  - 2. Tremco Sealants & Coatings
  - 3. 3M Fire Protection Products
  - 4. Dow Corning
  - 5. CSD Sealing Systems

### PART 2 PRODUCTS

#### 2.01 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.

#### 2.02 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 (2) 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.

#### 2.03 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.

## 2.04 FIRE RATED SEALS

- A. Modular mechanical type fire rated seals shall have zinc galvanized bolts and nuts with silicone rubber sealing element which provides a three hour fire resistance rating.
- B. Sealing plug type fire rated seals shall be made of FRR rubber for three hour fire resistance rating.

## 2.05 FIRESTOP MATERIALS

- A. Use only firestop products that have been UL and ASTM 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.
- B. 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.
- C. Sealants, foams or caulking materials for use with non-combustible items including rigid steel conduit and electrical metallic tubing (EMT).
- D. 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.
- E. Foams, intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles.
- F. Non curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles.
- G. Wall opening protective materials for use with UL listed metallic and specified nonmetallic outlet boxes.
- H. Non curing, re-penetrable materials shall be used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways and raceways.
- I. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.

## PART 3 EXECUTION

### 3.01 APPLICATION

- A. Provide sleeves for all conduit penetrations through walls, and through floors where above ground level. Sleeves are not necessary for slab-on-grade penetrations. (Refer to 26 00 30, Concrete Foundations, Supports, and Envelopes, for concrete collar requirements.)

- B. Provide one (1) spare sleeve of equal size in any floor or wall area where more than three (3) conduits penetrate floor or wall.

### 3.02 INSTALLATION

#### A. Sleeves

1. Carefully coordinate and check locations of sleeves immediately before and after each concrete pour and masonry installation.
2. 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.
3. Cut sleeves through walls flush with each surface. Unused sleeves shall extend beyond wall surface and be provided with caps.
4. Cut sleeves 3 1/2 inches above finished floors. Joint between sleeve and floor shall be caulked to be watertight. Bottom of sleeve to be cut flush.
5. Core drill holes for sleeves in existing construction.
6. Patching shall be by the General Trades Contractor at this Contractor's expense.

#### 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. .

### 3.03 INSPECTION

- 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.

END OF SECTION

SECTION 26 05 10 - WIRE AND CABLE

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish and install all electrical conductors for s feeder and branch circuit wiring and control wiring.
- B. Refer to other Division 26 Specification Sections for additional wiring requirements.

1.02 QUALITY ASSURANCE

- A. Wire and cable furnished shall be in accordance with the following standards where applicable:
  - 1. UL Standard 83 for thermoplastic insulated wires and cables
- B. Wire and cable shall be in accordance with applicable NEC Articles.
- C. Wire and cable shall be identified by surface markings indicating manufacturer, size, metal type, voltage rating, UL listing and cable type.

1.03 SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.
- C. Field quality-control reports.

1.04 MANUFACTURERS

Subject to compliance with requirements, provide products by one of the following:

- A. Conductors
  - 1. Cerrowire LLC
  - 2. Encore Wire Corporation
  - 3. General Cable, Prysmian Group
  - 4. The Okonite Company
  - 5. Service Wire Company
  - 6. Southwire Company
- B. Connectors and Splices
  - 1. Burndy, Hubbell
  - 2. Ideal Industries, Inc.
  - 3. ILSCO

## PART 2 PRODUCTS

### 2.01 TYPE "THHN/THWN-2" WIRING

- A. Wire shall be single conductor annealed uncoated copper with PVC insulation and nylon jacket. Insulation shall be heat and moisture resistant with light stabilized jacket. Wire shall be rated 600 volt, 90 degree C in dry locations, 75 degree C in wet locations.
- B. Conductors No. 10 AWG and smaller may be solid; No. 8 AWG and larger shall be stranded. Where stranded conductors of sizes 12 and 10 are used, appropriate crimp terminations shall be provided on the ends of each conductor for making connections to wiring devices, switches, etc.

### 2.02 CONNECTORS AND SPLICES DESCRIPTION

- A. Factory-fabricated connectors splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated.
- B. Splices in No. 10 AWG and smaller wire shall be made with insulated connectors with metallic coil springs and contoured wings such as 3M "Scotchlok," Ideal Company "Wing Nut," Thomas & Betts Company "Piggy" connectors, or with mechanically-crimped sleeves as manufactured by T & B or Ideal Company, which shall be insulated with pressure sensitive vinyl plastic electrical tape equal to Scotch No. "33" or No. "88." Push wire or incline connectors are not acceptable.
- C. All taps, terminations or splices, size No. 8 and larger shall be made with bolted-type pressure or compression connectors. Connectors shall be compatible with the conductor material. Insulate connectors with electrical tape to 150% of the insulating value of the conductor insulation. The tape shall have insulating properties equivalent to the conductor.
- D. All splices located in manholes, handholes and exterior junction boxes shall be made with waterproof splice kits.
- E. Lugs shall be one piece, seamless, designed to terminate conductors specified in this Section. Material shall be compatible with the conductor material. Two holes with standard barrels and compression terminations.

## PART 3 EXECUTION

### 3.01 APPLICATION

- A. All branch circuits, feeders and control wiring shall be Type "THHN/THWN-2."
- B. Unless otherwise noted, minimum wire size for power branch circuits shall be No. 12 AWG and for control and auxiliary systems No. 14 AWG. Wire size for branch circuit homeruns shall be as indicated in the panelboard schedules. Remainder of branch circuit shall be No. 12 AWG, unless noted otherwise.
- C. All conductors shall be copper

- D. Install electrical cables, wires and connectors as indicated, in compliance with Manufacturer's written instructions, applicable requirements of NEC and NECA'S "Standard Installation," and in accordance with recognized industry practices.
- E. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.
- F. No wire may be pulled until masonry and concrete is in place. Free ends and loops at boxes and enclosures are to be pushed back in box and protected by blank covers or other means until the interior painting and decorating work is completed.
- G. Leave at least 6 inches of free conductor at all outlets except where conductors are intended to loop without joints through outlets for luminaires or wiring devices hookups.
- H. Wire color and code shall be used as follows:

	120/208 Volt	277/480 Volt
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green
Isolated Ground	Green w/White Stripe	

Emergency: Same as normal, but with 1/2 inch red tape wrapped twice around wire at maximum 12 inch intervals at access points.

- I. All circuits shall have separate neutral conductors run for each phase conductor. Provide separate neutral conductor between each dimmer and load.
- J. Number of branch circuit conductors in a conduit including switch legs and neutral conductors shall not exceed nine (9) conductors. Conductors shall be derated in accordance with NEC Article 310 when more than three (3) current carrying conductors are installed in a raceway.
- K. Branch circuits shall be connected as numbered on the Drawings. Test and permanently tag by circuit number each circuit phase conductor in panelboard gutter before connecting to panelboard. Numbered adhesive tapes may be used at Contractor's option. Group neutral conductor and associated phase conductors with cable ties.
- L. Where a feeder or branch circuit exceeds the terminating lug size, the Contractor shall use an appropriate adapter fitting to reduce cable size. Cutting of conductor strands is not permitted.
- M. Emergency circuit wiring and ground fault circuit breaker wiring shall be installed in separate conduits from all other wiring.
- N. Use pulling means, including fish tape, cable or rope, and manufacturer approved compound or lubricant which will not damage raceway or deteriorate insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- O. Branch circuit conductor splices shall be kept to a minimum. Feeder conductors shall have no splices.
- P. Any equipment having multiple power connections shall have a warning label attached to each source where it connects to the equipment.
- Q. Subsequent to wire and cable hookups, energize circuitry and demonstrate functioning in accordance with requirements.
- R. Division 26 Contractor shall provide cords and plugs for equipment furnished by General Trades Contractor which is intended or shown for connection to a receptacle but not furnished with the equipment.
- S. Cables shall be supported inside of conduits and pullboxes as required by NEC in vertical risers. Provide pullboxes located as required – coordinate locations with Owner's representative.

### 3.02 CONDUCTOR SIZING

- A. Branch circuit conduit routing is not shown on the plans and is left to the discretion of the Contractor. Minimum wire size for 20A, 120 volt branch circuits shall be as follows, unless specifically noted on the Drawings:

<u>Conductor Size</u>	<u>Maximum Conductor Length</u>
#12 AWG	100 feet
#10 AWG	150 feet
#8 AWG	250 feet
#6 AWG	400 feet

- B. Wire size for under floor ducts shall be #8 AWG (minimum).

### 3.03 TESTING

- A. Refer to Section 26 08 40, "Electrical Tests, Adjustments, Inspection."
- B. Prior to energization, test cable and wire for continuity of circuitry and for short circuits.

END OF SECTION

SECTION 26 05 26 - GROUNDING & BONDING (EXTENSION)

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish and install a complete Grounding system extension as shown on the Drawings and specified herein. Provide all accessories as necessary for a complete system.
- B. All components of the electrical system shall be grounded and bonded including: raceways, enclosures, receptacles, motors, controllers, panelboards, contactors, luminaires, and all other electrical components and subsystems.

1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled and in accordance with applicable NEMA and ANSI Standards and NEC Article 250.
- B. Comply with UL 467 for grounding and bonding material and equipment.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.04 MANUFACTURERS

Subject to compliance with requirements, provide products by one of the following:

- A. Burndy, Hubbell
- B. ERICO, nVent
- C. Harger Lightning & Grounding
- D. ILSCO
- E. O-Z/Gedney, Emerson Electric Co.
- F. Thomas & Betts, ABB Group

PART 2 PRODUCTS

2.01 CONDUCTORS, CLAMPS AND CONNECTORS

- A. Insulated Conductors: Refer to Specification Section 26 05 10, "Wire and Cable."
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B3.



2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B31.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. System Grounding Connections
  1. All separately derived alternating current systems, such as 480 volt delta to 208/120 volt wye transformers, etc. shall be grounded and bonded as required in NEC Article 250.30.
- B. Enclosure and Equipment Grounding
  1. Metal enclosures or raceways for conductors or equipment shall be grounded.
  2. Exposed noncurrent-carrying metal parts of fixed equipment likely to become energized shall be grounded.
  3. Exposed noncurrent-carrying metal parts of switchboard frames and structures, motor frames, enclosures for motor controllers, and lighting fixtures shall be grounded.
- C. Method of Grounding
  1. Provide separate green insulated equipment grounding conductors with all feeders and branch circuits.
- D. Bonding
  1. Bonding shall be provided and conform to all requirements of NEC Article 250, Parts V and VII.
- E. Separately derived systems, such as transformers, shall be grounded to the nearest building steel column. If building steel is not available, then ground to the nearest domestic cold water pipe. In addition, run a grounding electrode conductor back to the main service entrance ground point. Grounding electrode conductor shall be bonded to conduit at each end.
- F. Motor terminal boxes shall be grounded by the use of a manufacturer supplied ground lug or by drilling and tapping a hole for a ground screw. Remove paint prior to making the connection.

END OF SECTION

## SECTION 26 05 29 - HANGERS AND SUPPORTS

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Furnish and install complete hangers, supports and concrete inserts as required for the installation of conduits, cabinets, transformers and equipment installed under Division 26.
- B. Provide all beam clamps, expansion anchors, threaded rod, framing steel and hardware as required.

#### 1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled and in accordance with applicable NEMA and ANSI Standards.

#### 1.03 MANUFACTURERS

- A. Hangers, Supports and Inserts
  1. GTE/Unistrut International Inc.
  2. Flex-Strut
  3. Kindorf/Midland Ross Corporation
  4. Grinnell
  5. Tufstrut - Pilgrim Technical Inc.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Conduits or raceways shall be securely supported and anchored with proper devices, using lead shields in walls or sides of beams, expansion shields or other approved type device for direct down-pull loads. Minerallac type hanger shall be limited to above ceilings. Holes made in walls or ceilings for use with anchoring devices shall be covered by large steel washers. Include special hangers, as required. Minerallac type fittings shall not be permitted within 8 feet of the floor surface where exposed raceways are installed.
- B. Hangers shall be individual ring or clevis type, one hole straps or multiple trapeze hangers.

#### 2.02 STRUCTURAL ATTACHMENTS

- A. Concrete: Use Grinnell Fig. 285, or equal, Light Weight concrete insert for loads up to 400 lbs., or Grinnell Fig. 282, or equal, Universal Concrete insert for loads up to 1430 lbs.
- B. Steel Beams: Where pipe size is 2 inches or less, use Grinnell Figure 87 or equal, Malleable iron C-Clamp and Retaining Clip. Where pipe size is over 2 inches, use Grinnell Figure 229, or equal.

- C. Intermediate Attachments: Continuous threaded rod shall be used wherever possible. No chain, wire or perforated strap shall be used. Up to 2 inches trade size pipe use 3/8 inch (minimum) rod, 2 1/2 inches and larger use 1/2 inch (minimum) rod.
- D. Pipe Attachments: For steel pipe use Grinnell Figure 115 Ring and Turnbuckle Adjuster, or Figure 260 Clevis.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Conduits shall be supported to meet the conditions as required using proper type and size straps, clamps, and hangers.
- B. Exposed conduits shall be installed parallel with or at right angles to building structure, fastened at least every 8 feet and at both sides of each outlet, except at one side only of conduit terminating outlets. Conduits shall be installed tight to structure and beams/joists. Coordinate exposed conduit routing with Architect prior installation.
- C. Conduit risers shall be supported with friction clamps with two point bearing anchored to building construction and at every floor.
- D. The following hanger methods are not permitted:
  - 1. Wood plugs
  - 2. Perforated band iron
  - 3. Hook chain supports
  - 4. Bailing wire, etc.
  - 5. Minerallacs where previously mentioned
  - 6. Friction type clamps, such as hammer on clips
- E. Whenever possible, use supports, clamps, hangers, etc., designed especially for the equipment to be installed.
- F. The maximum permitted load on hanger rod, plain or all-thread, shall be as follows:
  - 1. 1/4 inch size - 750 pounds
  - 2. 3/8 inch size - 1000 pounds
  - 3. 1/2 inch size - 2000 pounds
  - 4. 5/8 inch size - 3000 pounds
  - 5. The minimum size hanger rod permitted is 1/4 inch size.
- G. Any supports exposed to weather, shall be cleaned, primed and painted.

END OF SECTION

SECTION 26 05 33 - CONDUIT AND FITTINGS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Provide complete grounded conduit systems for all electrical conductors.
- B. All conduits shown on the Drawings shall meet NEC fill requirements for the conductors enclosed.
- C. Conduit raceway systems shall be made mechanically tight and electrically continuous throughout. All metal raceway systems shall be grounded.

1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled and in accordance with applicable NEMA and ANSI Standards.
- B. Conduit shall be in accordance with applicable NEC Articles.

PART 2 PRODUCTS

2.01 RIGID (RMC) AND INTERMEDIATE METAL CONDUIT (IMC)

- A. Conduit shall be steel, hot dipped zinc galvanized (minimum 0.0008 inch thick) inside and out, with circular cross section, uniform wall thickness, continuously welded seams and chamfered threaded ends. Conduit shall be furnished in 10 foot standard lengths.

2.02 ELECTRICAL METALLIC TUBING (EMT)

- A. EMT shall be zinc galvanized (minimum 0.0008 inch thick) inside and out, with circular cross section, uniform wall thickness and continuously welded seams. EMT shall be furnished in 10 foot standard lengths.

2.03 FLEXIBLE METAL CONDUIT (FMC)

- A. Conduit shall be steel or aluminum, hot dipped zinc galvanized inside and out and made from one continuous length of high grade strip of uniform weight and thickness shaped into interlocking convolutions with smooth interior and exterior surfaces. Conduit shall be provided in standard coil lengths.

2.04 LIQUID-TIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Conduit shall be hot dipped zinc galvanized inside and out and made from one continuous length of high grade strip of uniform weight and thickness shaped into interlocking convolutions with smooth interior and exterior surfaces. Conduit shall be provided in standard coil lengths.

- B. Conduit shall have a continuous PVC jacket enclosing it.

#### 2.05 CONDUIT FITTINGS

- A. All RMC, IMC, and EMT fittings shall be galvanized steel. Connectors and couplings shall be threaded, set screw or compression type, concrete-tight.
- B. Conduit bodies shall be threaded steel type. Provide neoprene cover gaskets for conduit body covers exposed to the weather.
- C. Expansion fittings, shall be O-Z/Gedney Type "AX" for RMC and Type "TX" for EMT. For IMC applications, a 15 inch minimum length of RMC shall be used with a Type "AX" expansion fitting. Provide O-Z/Gedney Type "BJ" bonding jumpers at all expansion fittings.
- D. Sealing fittings shall be Crouse Hinds Type EYD or Appleton Type EYD, with drain.
- E. RMC and IMC conduit bushings shall be of the insulated type with phenolic thermosetting insulation molded to a hot dipped galvanized steel body of the threaded type.
- F. EMT fittings shall be of the insulated throat type. Fittings larger than 2 1/2 inches shall have threaded bushings installed as described in Paragraph E above.
- G. Conduits larger than 1 inch shall have grounding type bushings.

#### 2.06 ROOF PENETRATIONS

- A. Use prefabricated pipe flashing of ultra-violet resistant EDPM rubber with ribbed aluminum base.
- B. Pate, Shipman, or Thy-Curb.

#### 2.07 ROOF SUPPORTS

- A. Rooftop conduit supports shall be UL listed for glue down installation.

### PART 3 EXECUTION

#### 3.01 APPLICATION

- A. All conduit shall be rigid metal conduit, unless noted otherwise below, minimum 3/4 inch trade size.
- B. EMT may only be used in these locations:
  1. Within interior partitions and exterior walls
  2. Above suspended ceilings inside building
  3. Exposed above 9 feet A.F.F. inside building (except in wet, hazardous, or corrosive locations)
  4. Exposed above electrical equipment in electrical and mechanical rooms.

- C. Intermediate metal conduit may be used at the Contractor's option in lieu of rigid steel conduit within the building interior.
- D. Flexible metal conduit up to 6 feet in length shall be used for connections to lighting fixtures. A green grounding conductor shall be installed in each flexible conduit as specified in Section 26 05 26, "Grounding." All runs shall be terminated in insulated flexible conduit fittings in accordance with NEC. Minimum size to be 1/2 inch.
- E. Liquid tight flexible metal conduit (up to 3 feet in length) and appropriate fittings shall be used for connections to motors, engine/generators, and vibrating equipment. A green grounding conductor shall be installed in each flexible conduit as specified in Section 26 05 26, "Grounding." All runs shall be terminated in insulated flexible conduit fittings in accordance with NEC. Minimum size to be 1/2 inch.
- F. EMT shall not be installed on the underside of metal roof decking.
- G. RMC conduit shall be used on roofs with appropriate expansion fittings.

### 3.02 INSTALLATION

- A. Generally, all conduits shall be concealed with runs installed parallel and perpendicular to walls and floor. Exposed conduits below 9 feet will be permitted only in electrical and mechanical rooms. Anywhere else at the discretion of the Architect or where specifically noted on the Drawings. In these cases, install conduit escutcheon plates around conduit penetration, sized to cover the conduit sleeve. Submit proposed routing of exposed conduits in finished spaces with Architect prior to installation.
- B. Branch circuit conduits shall not be run within concrete floors except for short runs to floor boxes.
- C. Conduit shall be securely and rigidly fastened in place with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, or ceiling trapeze. C-clamps and beam clamps shall have strap or rod-type retainers.
- D. Conduit support fastenings shall be by:
  - 1. Wood screws to wood
  - 2. Toggle bolts in hollow concrete masonry units
  - 3. Expansion bolts in concrete or brick
  - 4. Machine screws, welded threaded studs on steel work
  - 5. Nail-type nylon anchors or threaded studs driven by a powder charge and provided with lock washers and nuts for concrete, brick or steel work
  - 6. Conduit shall not be supported using wire or nylon ties.
- E. In areas without ceilings, conduits shall be run as high as possible attached to the structure of the roof, or of the floor deck above. Do not attach directly to the metal deck. Conduits shall be run next to walls as inconspicuously as possible. In finished areas exposed to public view without ceilings, all work shall be installed in an aesthetically acceptable manner. The Architect reserves the right to require the Contractor to make changes as necessary to equipment installation that is unsuitable for public view due to poor workmanship.

- F. Install conduit sleeves for all conduit penetrations through floors, masonry walls, and fire rated walls. Refer to Section 03 30 00, "Concrete" for spacing requirements. Sleeves shall be spaced a sufficient distance apart to maintain fire ratings as required by the UL Fire Resistance Construction Manual.
- G. Conduit shall be independently supported from elements of the building and shall not rest on, nor be supported from suspended ceilings. Boxes shall be fastened to structure independently from conduit system. Conduits shall not be attached to metal decking forming the roof or floor slab above.
- H. Lay out conduit system to avoid crossing building expansion joints. Where crossings are necessary, use expansion fittings.
- I. All conduits shall be continuous from outlet to outlet or junction box, and installed complete before pulling conductors. Swab conduits free of dirt, grease and moisture before pulling conductors.
- J. Install bushings on all RMC and IMC conduit ends. Install insulated throat fittings on all EMT conduit ends. Fasten conduit to boxes and cabinets using locknuts. Provide two (2) locknuts where required by the NEC, where insulating bushings are used and where bushings cannot be brought into firm contact with the box.
- K. All conduits entering or leaving refrigerated, subject to different temperatures or moisture-laden spaces shall be sloped away from equipment and secured with sealing fittings. Secure conduits with threaded hubs to prevent air circulation and condensation.
- L. Do not install conduits beneath nor above equipment generating heat such as boilers, heat exchangers or water heaters.
- M. Provide a high strength pull cord in all empty conduits, and cap ends.
- N. Maintain minimum clearances of 6 inches from parallel hot water piping and 4 inches from crossovers.
- O. Provide conduit sleeves, seals and firestops in accordance with Section 26 00 55, "Sleeves, Seals and Firestops."
- P. Provide expansion joints in conduits run on roofs and exterior to building above grade. Provide proper roof flashing and sealing when penetrating roofs.
- Q. Install cable wedging plug type supports in all vertical conduit runs as required by NEC.
- R. Do not exceed four (4) 90 degree bends in any conduit run without a pulling point. Provide pullboxes as required. Locate pullboxes in accessible areas. Coordinate locations with all other building Trades.
- S. Roof support steel shall be galvanized.

END OF SECTION

## SECTION 26 05 36 - PULL AND JUNCTION BOXES

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Pull or junction boxes shall be provided in all raceway systems where required to avoid an excessive number of bends, to facilitate wire pulling, or to afford required access to the raceway system. Maximum distance between boxes in raceway systems shall not exceed 100 feet.
- B. Pull and junction boxes shall provide adequate space and dimensions for the installation of conductors in accordance with NEC Article 314.

#### 1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled and in accordance with applicable NEMA and ANSI Standards.

### PART 2 PRODUCTS

#### 2.01 PULL AND JUNCTION BOXES

- A. Pull and Junction Boxes: Provide galvanized code-gauge sheet steel junction and pull boxes, with screw-on covers, of types, shapes and sizes, to suit each respective location and installation. Minimum size shall be 4 inch square, 2 1/8 inch deep box.
- B. Concealed pull or junction boxes shall be flush in finished walls, located near the floor and provided with flush type covers; blank device plates in case of outlet type boxes and flat plates prime painted and secured with flat head screws in the case of larger boxes. Surface junction boxes in utility areas shall be without knockouts, shall have close fitting screw covers and shall be finished in medium gray enamel.
- C. Boxes exposed to the weather shall be weatherproof type as required by NEC.
- D. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes to suit respective uses and installation.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install pull and junction boxes, complying with Manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in compliance with recognized industry practices.



- B. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
- C. Pull and junction boxes shall be located in utility areas or above accessible ceiling systems wherever possible. Boxes located in exposed areas shall be brought to the attention of the Architect prior to installation.
- D. Pull and junction boxes shall be sized in accordance with the NEC for both contained conductors and conduit entrances and exits.
- E. Fasten boxes rigidly to structural surfaces, or solidly imbed electrical boxes in concrete or masonry.
- F. Boxes not otherwise accessible in ceilings and walls shall be made accessible by an access panel.
- G. Provide watertight boxes, slip expansions or bonding jumpers where dictated by construction conditions.

END OF SECTION

## SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

### PART 1 GENERAL

#### 1.01 NAME PLATES

- A. Furnish and install equipment identification nameplates on all pieces of electrical equipment including, but not limited to:
1. Safety Switches
  2. Motor Starters
  3. Panelboards
  4. Switchboards
  5. Transformers
  6. Each Switch, Circuit Breaker, Spare, and Space in new and existing Distribution Panelboards and Switchboards

Identify and label all existing circuits and equipment that are located within the contract construction area.

- B. Refer to Section 26 05 10, "Wire and Cable" for color code identification of wire and cable.
- C. Refer to Section 26 24 20, "Panelboards" for branch circuit identification.

#### 1.02 JUNCTION BOX IDENTIFICATION

- A. Junction boxes in conduit runs shall be color coded and labeled as to the system that they have within. Each system shall have a different color or labeling scheme used. Do not color code in finished areas without ceilings.
- B. Electrical power and lighting branch circuit junction boxes shall be painted, but labeled with the circuit numbers contained within. Labeling may be done with paint stencils or permanent black felt-tip markers.
- C. Special systems shall have junction boxes painted as follows:
1. Fire Alarm - Red
  2. Normal – Silver
  3. Lighting – Black

### PART 2 PRODUCTS

#### 2.01 NAMEPLATES

- A. Nameplates for equipment shall be Safe-T-Mark Style matte non-glare finish with engraving depth no less than 0.003". Provide nameplate suitable for outdoor use for equipment installed outdoors. Letter type shall be minimum 3/8 inch high for equipment name and 1/4 inch high for details. All uppercase letters.

- B. Nameplates for wiring device cover plates shall be laminated adhesive plastic tape minimum of 1/4 inch high and all uppercase letters.
- C. Color of nameplates shall be white with black letters for normal power systems and red with white letters for emergency power systems.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install nameplates on equipment using cadmium plated, steel, self-tapping screws or rivets.
- B. Nameplates shall be installed on the front cover or trim of each piece of equipment. Where not possible, install on wall next to equipment using hollow-wall anchors.
- C. Horsepower, ampacity, or kilowatt values shall be taken from the equipment as delivered in the field, not from the Drawings.
- D. Wiring device cover plate nameplates shall be installed at top of cover plate.

#### 3.02 EXISTING EQUIPMENT IDENTIFICATION

- A. Provide nameplates on all existing equipment within building as listed in Paragraph 1.01.A. of this Specification Section.
- B. Provide updated panelboard directories in all existing panelboards within building as required for new panelboards per Section 26 24 20, "Panelboards," Paragraph 3.01.

END OF SECTION

SECTION 26 08 40 - ELECTRICAL TESTS, ADJUSTMENTS, INSPECTION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish equipment and perform as necessary all testing as required herein and called for in other Division 26 Specification Sections. Perform adjustments of equipment as required. Arrange for inspections by the authority having jurisdiction.

1.02 QUALITY ASSURANCE

- A. Testing equipment shall be UL listed and specially manufactured and appropriate for the intended type of testing to be performed.
- B. All testing shall be witnessed by Owner's Representatives. Provide five days advance notice.

1.03 SUBMITTALS

- A. For Review:
  - 1. Test results form (attached to the end of this Section) with all recorded data sheets and graphs
- B. To be included in Record and Information Manuals:
  - 1. One (1) copy of each approved submittal
  - 2. Final Certificate of Inspection

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 TESTING

- A. Amperage Phase Balance
  - 1. Test and record amperage of each phase at main switchboard, each branch distribution panel, and all lighting and appliance panels.
- B. Continuity of Conduit System
  - 1. Test each run of metallic conduit for continuity of ground return path.
- C. Conductor Insulation Leakage
  - 1. Test each run of 600 volt cable for insulation leakage. Use the short-time method with readings taken at 30 and 60 seconds. Record results for conductors used for switchboard and panelboard feeders.

- D. Dielectric Strength
  - 1. Provide megger test of all transformers to verify dielectric strength.
  - 2. No load/low load loss for medium voltage transformers.

### 3.02 ADJUSTMENTS

- A. Amperage Phase Balance
  - 1. Where Contractor has deviated from panelboard circuit arrangement as shown on the Drawings, perform a phase balancing within the panelboard by rearranging the position of selected circuit breakers. Record the changed circuits on the "As-Built" Drawings.
- B. Conductor Insulation Leakage and Impedance
  - 1. Where insulation leakage is above Manufacturer's stated values, replace conductor.
- C. Other Adjustments
  - 1. Refer to Division 26 Specification Sections for additional adjustments.

### 3.03 INSPECTION

- A. Inspection shall be performed by:
  - 1. Local authorized inspection agency, or
  - 2. State division of Inspection
- B. Contractor shall arrange for periodic and final inspections in a timely manner and with due regard for the work of other Contractors and the Construction Schedule.
- C. Include final Certificate of Inspection in the Record and Information Manuals.

END OF SECTION

TEST RESULTS FORM

PROJECT NAME:

CONTRACTOR:

SYSTEM:

SPECIFICATION SECTION NUMBER:

TYPE OF TEST:

EQUIPMENT USED:

WEATHER CONDITIONS:

TEMPERATURE:

HUMIDITY:

PART OF SYSTEM TESTED:

SUMMARY OF TEST:

PERSON PERFORMING TEST: \_\_\_\_\_ DATE: \_\_\_\_\_

CONTRACTOR'S REPRESENTATIVE: \_\_\_\_\_

(Attach Recorded Testing Data Sheets To This Form)

CERTIFICATE OF SYSTEM APPROVAL

PROJECT NAME: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_

SYSTEMS COMPONENT: \_\_\_\_\_

SPECIFICATION SECTION NUMBER: \_\_\_\_\_

A. APPROVAL (If required by specification section)

The above listed system has been inspected and approved as meeting the specified instructions for installation.

Owner's Representative: \_\_\_\_\_ Date: \_\_\_\_\_

B. EQUIPMENT DEMONSTRATION

The above listed system has been demonstrated to the following Owner's Representatives:

	<u>NAME</u>	<u>TITLE</u>	<u>DATE</u>	<u>SIGNATURE</u>
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

(ATTACH A SEPARATE PAGE FOR ADDITIONAL NAMES)

## SECTION 26 24 20 - PANELBOARDS

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Furnish and install circuit breaker panelboards as indicated in the panelboard schedules and as shown on the Drawings.
- B. Provide all circuit breaker devices and accessories as noted on the Drawings, herein specified, and as required.
- C. Short circuit ratings shall be as shown on the Drawings. Equipment shall be fully rated; series ratings are not permitted.
- D. Provide lug sizes as necessary for cable sizes as shown on the Drawings.

#### 1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled and in accordance with applicable NEMA and ANSI Standards.
- B. Branch circuit breakers shall be UL listed as SWD (switching duty) for single pole 15 and 20 Ampere circuits.
- C. Branch circuit breakers feeding HVAC equipment shall be "HACR" rated.

#### 1.03 SUBMITTALS

- A. For Review:
  - 1. Product data sheets of panelboards and devices
  - 2. Schedules showing quantities, sizes, and arrangement of devices
- B. To be included in Record and Information Manuals:
  - 1. One (1) copy of each approved submittal
  - 2. Accurate panelboard directories based on the schedules on the Drawings, but updated per as-built changes

#### 1.04 MANUFACTURERS

Subject to compliance with requirements, provide products by one of the following:

- A. Panelboards
  - 1. Square D Company
  - 2. Eaton Corporation
  - 3. Siemens Energy & Automation, Inc.
  - 4. GE by ABB



## PART 2 PRODUCTS

### 2.01 CIRCUIT BREAKER PANELBOARDS

#### A. Types

1. Panelboards shall be molded case circuit breaker type with dead front construction.
2. Panelboards for 208Y/120 volt, 3 phase, 4 wire service shall be Square D Type NQ with Type "QOB" bolt on thermal magnetic molded case circuit breakers, (maximum depth of 5 3/4 inches). 22,000 AIC minimum.
3. Panelboards for 480Y/277 volt, 3 phase, 4 wire service shall be Square D Type NF with Type "EDB or EGB" bolt on thermal magnetic molded case circuit breakers (maximum depth of 5 3/4 inches). 35,000 AIC minimum.

#### B. Boxes

1. Boxes shall be constructed of commercial, galvanized, code gauge sheet steel, surface or flush mounted as scheduled on the Drawings.
2. Boxes for panelboards shall be sized to provide code gutters but to have minimum width of 20 inches and a maximum depth of 5 3/4 inches.
3. Boxes for double tub panels shall be same size in height.
4. Boxes shall have sufficient wire bending space to accommodate conductor sizes as shown on the Drawings.
5. Panelboard enclosures shall not have any openings that would compromise Arc-Flash safety levels.
6. Rated for environmental conditions at installed location.
  - a. Indoor dry and clean locations: NEMA 250, Type 1.

#### C. Bussing

1. Bus bars shall be copper or tin-plated aluminum and arranged and drilled for sequence phasing.
2. Equipment ground bus shall be provided in each panelboard in addition to any neutral bus requirements. Bus to have same number, size, and type of anti-turn solderless lugs neutral assembly has. Ground bus to be factory bonded to panelboard tub.
3. Provide full size neutral bus with suitable lugs for each outgoing feeder requiring a neutral connection.

#### D. Mains

1. Provide main breakers for panelboards of the type and class indicated on the Drawings. Panelboards without main breakers are to be provided with solderless type incoming lugs suitable for either copper or aluminum conductors sized to accommodate wiring as shown on the Drawings.

#### E. Arrangement

1. Panelboards shall have respective main and branch breakers including spares, provisions for future breakers and spaces arranged in accordance with panelboard schedule to facilitate field wiring and be in agreement with branch circuiting shown on the Drawings.
2. Panelboards equipped with multiple pole circuit breakers shall have circuit numbers based on single pole position. Multiple pole breakers and spaces shall be identified by top single pole position number of that breaker.

- F. Branch Circuit Breakers
  - 1. Thermal magnetic molded case circuit breakers with bolted bus connections.
  - 2. Breakers shall have an over center, trip-free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication.
  - 3. Ground fault protection (GFP) type circuit breakers shall be rated for 30 milliamp trip setting, up to 60 Amperes/2 pole configuration at 22,000 AIC. GFP type circuit breakers shall be used for equipment protection only, interior and exterior to the building (snow/ice melting equipment, heat trace, or pool/pond pumping and lighting equipment).
  - 4. Ground fault circuit interrupter (GFCI) type circuit breakers shall be rated for five milliamp trip setting, up to 50A, 120V and 100A, 208V, 3-pole configuration at 22,000 AIC. GFCI type circuit breakers shall be used for personnel protection interior and exterior.
  - 5. Branch circuits shall be connected for sequenced phasing, i.e., circuits No. 1 and 2 connected to Phase A; circuits No. 3 and 4 connected to Phase B; etc. to conform with the branch circuit numbering system on the Drawings. "Polarity" or "Block" phasing will not be acceptable.
  - 6. Scheduled lock-on devices for certain branch circuits are to be furnished and installed which prevent manual operation of breaker handle but not impede trip-free capability of breaker.
  
- G. Trims
  - 1. Door and trim finish shall be Manufacturer's standard lacquer or enamel.
  - 2. All trim shall be made for surface or flush mounted panelboards as scheduled on the Drawings and hinged to back box for "door in door" design. Doors shall be equipped with totally concealed hinges and trim clamps and flush chrome-plated combination locks and catches, all keyed alike. Fronts shall not be removable with door in the locked position.
  - 3. Furnish two (2) keys for each panelboard installed and one (1) pint of touch-up enamel paint.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Coordinate location of panelboards with the work of other Contractors. Installation shall meet the requirements of NEC Article 110.26, NECA 1, and NEMA PB 1.1.
- B. Securely install panelboards to the vertical finished or structural surface behind the panelboard.
- C. Install panelboard cabinets (box) at a height such that highest circuit breaker does not exceed 6'-6" above floor.
- D. Install surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

- E. Furnish directory frames inside the door of each panel which shall contain a correct typewritten directory card, properly filled out to correspond to the circuit numbers on the Drawings and the room numbers of loads served. If room numbers assigned by the Owner do not match the room numbers on the Drawings, both sets of room numbers must be cross-referenced and identified in the panel directory.
- F. All flush panelboards shall have a 3/4 inch spare conduit rising and turning out of the wall above the ceiling line for every three (3) spares and spaces in the panelboard.
- G. Clean interior and exterior of equipment. Touch-up all scratched finishes. Vacuum out all debris in enclosure before energizing.
- H. Provide nameplates in accordance with Section 26 05 53, "Electrical Identification."
- I. Deliver keys and touch-up enamel to Owner's Representative. Refer to Section 26 00 99, "Requirements for Contract Completion."
- J. Install panelboard cabinet plumb and rigid without distortion of box.
- K. Install recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- L. Install filler plates in unused spaces.
- M. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

END OF SECTION

## SECTION 26 28 13 - FUSES

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Furnish and install 600 volt and 250 volt fuses as herein specified and sized as shown on the Drawings.
- B. Provide all accessories as specified.
- C. All fuses shall be provided by the same Manufacturer.

#### 1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled and in accordance with applicable NEMA and ANSI Standards.
  - 1. Comply with NEMA FG1.

#### 1.03 SUBMITTALS

- A. For Review:
  - 1. Product data sheets of fuses and accessories
  - 2. Fuse curves and selectivity ratio charts
- B. To be included in Record and Information Manuals:
  - 1. One (1) copy of each approved submittal
  - 2. Certificate of Material Receipt

#### 1.04 MANUFACTURERS

Subject to compliance with requirements, provide products by one of the following:

- A. Fuses
  - 1. Bussmann
  - 2. Littelfuse
  - 3. Mersen

### PART 2 PRODUCTS

#### 2.01 FUSES - 601 AMPERES AND ABOVE

- A. Fuses shall be 600 volt, UL Class L, current limiting, 200,000 Ampere interrupting rating with minimum time delay of 4 seconds at 500 percent rating. Fuse terminals shall be silver-plated, and fuse links shall be silver.
  - 1. Bussmann KRP-C HI-CAP

2.02 FUSES - 600 AMPERES AND BELOW

- A. Fuses shall be rated 600 volt for nominal 480 volt systems and 250 volt for nominal 240 or 208 volt systems. Fuses shall be UL Class RK, current limiting, 200,000 Ampere interrupting rating, dual element, with minimum time delay of 10 seconds at 500 percent rating.
  - 1. Bussmann LPN-RK (250 volt) or LPS-RK (600 volt)
- B. Motor control circuits shall use 600 volt, UL Class CC, current limiting, 200,000 Ampere interrupting rating, single element, non-time delay fuses.
  - 1. Bussmann KTK-R

2.03 FUSE REDUCERS

- A. Fuse reducers shall be Bussmann 200-R or 600-R Series.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install fuses in all fusible devices with name and fuse size facing outward.
- B. Install spare fuse cabinets in main electrical room. Provide a list of all spare fuse sizes, types and quantities on inside of door.
- C. Install fuse reducers in equipment where required.
- D. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.
- E. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- F. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

3.02 SPARE PARTS

- A. Provide spare fuses in the following quantities:
  - 1. 601 Amperes and above - three (3) of each current rating
  - 2. 600 Amperes and below - 10% of quantity used (minimum three (3)) of each voltage and current rating and UL Class
- B. Refer to Section 26 00 99, "Requirements for Contract Completion."

END OF SECTION

## SECTION 26 28 16 - SAFETY SWITCHES

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Furnish and install safety switches where shown on the Drawings, and where required including all accessories and mounting hardware.

#### 1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled and in accordance with applicable NEMA and ANSI Standards.
  - 1. Comply with NEMA KS 1.
  - 2. Comply with UL 98.

#### 1.03 SUBMITTALS

- A. For Review:
  - 1. Product data sheets of safety switches
- B. To be included in Record and Information Manuals:
  - 1. One (1) copy of each approved submittal

#### 1.04 MANUFACTURERS

Subject to compliance with requirements, provide products by one of the following:

- A. Safety Switches
  - 1. Square D Company
  - 2. Cutler-Hammer Electric Corporation
  - 3. Siemens Energy & Automation, Inc.
  - 4. GE by ABB
- B. AC manual toggle disconnect switch
  - 1. Leviton
- C. Equipment shall be furnished by the Manufacturer supplying major components of the electrical distribution system.

### PART 2 PRODUCTS

#### 2.01 SAFETY SWITCHES - NON-FUSIBLE

- A. Safety switches shall have heavy-duty, single-throw, quick-make, quick-break, visible knife blade operators mounted in hinged cover steel enclosure. Lugs shall be listed for 75 degrees C ampacity aluminum or copper wire.

- B. Switches shall be clearly labeled for "ON" and "OFF" handle positions. Cover shall have defeatable safety interlock with handle to prevent inadvertent opening when in the "ON" position. Handle shall be pad lockable in the "OFF" position with at least three (3) padlocks.
- C. Safety switches to be horsepower rated 600 volt AC.
- D. Switches shall have ground lug kit and neutral when required.
- E. Non fusible switches shall be series-rated with upstream devices in accordance with manufacturer's application date.

#### 2.02 SAFETY SWITCHES - FUSIBLE

- A. Fusible safety switches shall be as specified in Paragraph 2.01 and with the following additional features:
  - 1. Safety switches rated 600 Amperes and less shall have spring reinforced, plated fuse clips with rejection feature for Class R fuses.
  - 2. Safety switches rated larger than 600 Amperes shall have provisions for Class L fuses.
  - 3. Short circuit-interrupting rating shall be 200,000 Amperes RMS symmetrical.
  - 4. Safety switches to be horsepower rated 240 volt AC for 208 or 240 volt usage, and 600 volt AC for 480 volt usage.

#### 2.03 AC MANUAL TOGGLE DISCONNECT SWITCHES

- A. Toggle disconnect switch shall be snap switch with copper mechanism, silver alloy contacts, 10,000 Ampere withstand rating, in a NEMA 1 enclosure. 1, 2, or 3 pole with amperages of 30 to 60 Amperes, as required for load connected.

### PART 3 EXECUTION

#### 3.01 APPLICATION

- A. Provide the following NEMA rated enclosure types in these locations:
  - 1. Interior, dry and clean locations: NEMA 250, Type 1.
  - 2. Exterior locations: NEMA 250, Type 3R.

#### 3.02 INSTALLATION

- A. Use flexible conduit to and from safety switches where vibration isolation is required.
- B. Install safety switches securely to building structure. Install safety switches on freestanding metal framing system support where mounting to building structure is not feasible or where shown on the Drawings. Framing system shall be galvanized steel.
- C. Safety switches located downstream of variable frequency drives shall have auxiliary control power interlock switch on handle. Run wiring to variable frequency drives.
- D. Provide fuses sized in accordance with Equipment Manufacturer's data plate.

- E. Provide nameplates in accordance with Section 26 05 53, "Electrical Identification."
- F. Touch-up all scratches on enclosure after installation.

END OF SECTION



## SECTION 26 28 19 - CIRCUIT BREAKERS

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Furnish and install circuit breakers in switchboards, distribution panelboards, and separate enclosures for overcurrent protection for panelboards, transformers and equipment, as shown on the Drawings and specified herein. Provide all accessories as necessary.
- B. Short circuit ratings shall be as shown on the Drawings.
- C. Refer to Section 26 24 20, "Panelboards" for circuit breakers in panelboards.
- D. Provide frame size of circuit breaker with lug size as required to accommodate feeder size as shown on the Drawings.
- E. Provide frame size, plug size, and trip units as necessary to meet short circuit ratings, and to provide selective coordination (down to 0.01 seconds) on emergency power distribution systems.
- F. All circuit breakers shall be fully rated for short circuit levels indicated. Series ratings are not permitted.

#### 1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled and in accordance with applicable NEMA and ANSI Standards.

#### 1.03 SUBMITTALS

- A. For Review:
  - 1. Product data sheets for all circuit breakers and components
  - 2. Wiring diagrams
- B. To be included in Record and Information Manuals:
  - 1. One (1) copy of each approved submittal
  - 2. Test results
  - 3. Manufacturer Representative's signed Certificate of Inspection and Approval

#### 1.04 MANUFACTURERS

Subject to compliance with requirements, provide products by one of the following:

- A. Circuit Breakers
  - 1. Siemens Energy & Automation, Inc.
  - 2. Cutler-Hammer/Eaton Corporation
  - 3. Square D Company
  - 4. GE by ABB

## PART 2 PRODUCTS

### 2.01 MOLDED CASE CIRCUIT BREAKERS WITH THERMOMAGNETIC TRIP

- A. Molded case circuit breakers shall be bolt-on type operated by a toggle type handle and shall have quick-make/quick-break over-center switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions.
- B. Breakers must be completely enclosed in a molded case. Non-interchangeable trip breakers shall have their covers sealed; interchangeable trip breakers shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Arc extinction must be accomplished by means of arc chutes.
- C. Molded case breakers shall be of the thermal magnetic standard type that provides inverse time delay overload and instantaneous short circuit protection by means of a thermal magnetic element.
- D. Single phase circuit breakers shall be balanced among the three (3) phases.
- E. All circuit breakers shall have an integral lock-out/tag-out means.
- F. High magnetic withstand circuit breaker type shall utilize higher trip levels of 18 to 20 times the breaker handle rating.

### 2.02 MOLDED CASE CIRCUIT BREAKERS WITH SOLID STATE TRIP

- A. Circuit protective devices shall be molded case type circuit breakers UL Listed for 80% continuous current with full function trip system. Frame/Sensor ampere ratings shall be as shown on the Drawings. The ampere rating shall be clearly marked on the front of the circuit breaker. Circuit breakers shall be of fixed construction.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material providing high dielectric strength. Current carrying components shall be completely isolated from the trip unit and accessory mounting area. Breakers shall have common tripping of all poles and shall be trip free. The breakers shall have quick-make/quick-break contacts with an over center toggle operating mechanism. All circuit breakers shall be equipped with electrical accessories as noted on the Drawings.
- C. The integral electronic trip system shall be independent of any external power source and shall contain electronic components to measure and time the output from internal current sensors and initiate automatic tripping action. The continuous ampere rating of the circuit breaker shall be determined by the combination of the ampere rating switch position, and the frame/sensor size of the circuit breaker. The resulting ampere rating shall be clearly marked on the face of the circuit breaker. Provide a means to seal the trip unit adjustments to discourage unauthorized tampering to meet the requirements of NEC Article 240.6.

- D. Provide the following time/current curve shaping adjustment to maximize system selective coordination. Each adjustment shall have discrete settings and shall be independent from all other adjustments:
  - 1. Adjustable Long Time Ampere Rating and Delay
  - 2. Adjustable Short Time Pickup and Delay (delay includes  $I^2t$  in and  $I^2t$  out)
  - 3. Fixed Instantaneous Trip
  - 4. Ground fault trip (where shown on one line diagram). Provide indication only on devices supplied by emergency power system.
- E. Provide local visual trip indication for overload, short circuit occurrences. The trip system shall include a memory circuit to detect intermittent overcurrent conditions. Each circuit breaker trip system shall be equipped with an externally accessible test port for use with a Universal Test Set. No disassembly of the circuit breaker is required for testing. Test set shall be capable of verifying the operation of all trip functions with or without tripping the circuit breaker.
- F. All circuit breakers shall have an integral lock-out/tag-out means.

### PART 3 EXECUTION

#### 3.01 APPLICATION

- A. 15 Ampere through 250 Ampere circuit breakers shall be molded case with thermomagnetic trip sensor and mechanism.
- B. 300 Ampere and above shall be molded case with solid state trip sensor and mechanism.
- C. Provide the following NEMA rated enclosure types for single circuit breakers in these locations:
  - 1. Interior, dry and clean locations: NEMA 250, Type 1.
  - 2. Exterior locations: NEMA 250, Type 3R.

#### 3.02 INSTALLATION

- A. Install circuit breakers in switchboards, distribution panelboards or enclosures as shown on the Drawings and in accordance with Manufacturer's written instructions.
- B. Provide nameplates in accordance with Section 26 05 53, "Electrical Identification."

#### 3.03 TESTING

- A. Perform a complete functional test of all features of circuit breakers in accordance with Manufacturer's recommendations. Submit written documentation in Record and Information Manuals.

END OF SECTION

SECTION 26 81 10 - FIRE ALARM SYSTEM (SMALL)

PART 1 GENERAL

1.01 DESCRIPTION

- A. Division 26 Contractor shall furnish and install all equipment and accessories for a complete local, manually and automatically actuated, electrically operated, device annunciated, double supervised, non-coded 24 VDC fire alarm system as described herein and as shown on the Drawings.

1.02 QUALITY ASSURANCE

- A. Fire alarm installation shall conform to the requirements of the NFPA 101, Life Safety Code, the Ohio Building Code, and Local Code and Building Authority requirements.
- B. All equipment shall be UL listed and labeled, and in accordance with applicable NEMA and ANSI Standards and Codes:
  - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) ANSI/ASHRAE Standard 135-1995 BACnet
  - 2. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the U.S.
  - 3. National Electrical Code (NFPA 70)
  - 4. FCC Part 15, Subpart J
  - 5. EMC Directive 89/336/EEC
  - 6. NFPA 72
- C. All devices and installation shall be in accordance with the Americans with Disabilities Act.

1.03 SUBMITTALS

- A. For Review:
  - 1. Product data sheets of all components.
  - 2. Riser/wiring diagrams and plans of entire system showing all devices, quantity and size of wires, conduit sizes, zone schedule, sound levels, types of audible devices.
  - 3. Power supply, amplifier and battery calculations indicating operating time and spare capacity for additional devices.
  - 4. Voltage drop calculations for strobe circuits.
- B. To be included in Record and Information Manuals:
  - 1. One (1) copy of each approval submittal
  - 2. Certificate of Material Receipt
  - 3. Certificate of System Completion

- C. Submit shop Drawings to the appropriate Building Authority's office for review after approval by the Architect. These drawings shall include the following statement:

Korda/Nemeth Engineering, Inc., 1650 Watermark Drive, Suite 200, Columbus, Ohio 43215 as shown on the Construction Documents and as required by the OBC, designed the fire protective signaling system for this project. The [Insert Company Name] project Drawings are provided with Manufacturer's installation and wiring recommendations to assist in the installation. Korda/Nemeth Engineering, Inc., Job # \_\_\_\_\_.

[Insert Designer Name]  
[Insert Company]  
[Insert City, State]  
NICET Level \_\_\_\_\_  
Fire Protection System Designer  
[Insert, Name]  
[Certification # \_\_\_\_\_, valid through \_\_\_\_\_]

#### 1.04 MANUFACTURERS

- A. Fire alarm system components shall be as manufactured and/or certified by Manufacturer to work as a complete and functional system.

#### 1.05 SYSTEM OPERATION

- A. All air handling units and return air fans shall shut down when smoke is detected by return air duct mounted smoke detectors at the unit. Shutdown shall be achieved by relay closure signaled by the fire alarm panel. Exact location of smoke detectors shall be coordinated with Division 23 Contractor.
- B. Fire alarm system shall have an auxiliary relay module for each air handling unit (AHU). This relay shall close upon smoke detection by any smoke detector associated with that air handler in ductwork or at fan powered VAV terminal boxes. Division 23 shall wire to temperature control system.
- C. Each fan powered VAV HVAC terminal box or fan coil unit shall have a duct mounted smoke detector installed in the return air duct, with auxiliary relay base. Shutdown wiring is by Division 23.
- D. Area type spot smoke detectors shall be installed within the HVAC ductwork for each smoke damper and combination fire/smoke damper. Smoke detector shall have auxiliary relay base and remote alarm light. Wiring to smoke damper shall be by Division 23 Contractor.

## PART 2 PRODUCTS

### 2.01 SMOKE DETECTORS

- A. Area smoke detectors shall be analog addressable smoke sensor type photoelectric devices that communicate smoke density values to the fire alarm control panel. Sensors shall have integral insect screens and RFI shielded electronics in a white plastic head and base. Detector base shall be addressable. Bases shall have LED status indicating light and locking tamper resistant screw. Detectors performing auxiliary control function such as elevator recall, smoke damper closing, or fire door release shall be associated with a Programmable Relay Module to perform the intended operation.
- B. Duct mounted smoke detectors shall be similar to area smoke detectors but with sampling tube as required to span HVAC duct width, and remote LED indicator station. Addressable relay control module shall be provided for equipment shutdown. Housing shall be NEMA 4 gasketed and weatherproofed with internal heating means for applications where detector is located in an unheated space or on roofs. Tamper switch on cover. UL listed for 100-4000 fpm air velocity.
- C. Remote LED indicator stations shall have a red status LED.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Follow Manufacturer's written instructions regarding mounting, wiring, and testing the fire alarm system. Installers shall be certified for fire alarm work by State Agencies.
- B. Conductors shall be UL listed to work with manufacturer's equipment. Installation shall be in accordance with the Manufacturer's wiring diagrams, recommendations, and in compliance with practices set forth by local, State and National fire codes. Color code and tag all wires at all junction points. Do not exceed 40% conduit fill capacity. All cables shall be UL listed for Fire Alarm Application. Fire alarm wiring shall be red. Conductors shall be Types FPLP and FPLR, inner and outer insulation: LS PVC-Low Smoke Polyvinyl Chloride, 75 degrees C, NFPA 262.
- C. Duct mounted smoke detectors and duct mounted area detectors shall be installed in return ducts as directed by the mechanical equipment supplier under the supervision of the Division 23 Contractor, in a location that is accessible. Provide wiring to mechanical control equipment as necessary to achieve equipment control upon smoke detection. Install remote test stations at 60 inches above finished floor on adjacent wall in utility spaces, or in ceiling below duct detectors. Install label on each station identifying application.
- D. All wiring shall be installed in conduit and independent of all other systems. Paint all junction boxes with red paint and label "Fire Alarm." Wiring configuration shall be "Class A" with return circuit permitted in same conduit.

- E. Smoke detectors located on either side of smoke doors and smoke shutters shall be installed between 1 foot and 5 feet of the door and connected to release magnetic door holders. Motorized smoke shutters with electric release shall have control power run from shutter operator through relay base of each smoke detector to electric release mechanism.

### 3.02 TESTING

- A. Each zone in the fire alarm control panel and remote annunciator and each device shall be individually tested as installed in the building under the supervision of an authorized Manufacturer's Representative. Division 26 Contractor shall include in his/her bid, time for testing after normal work hours.
- B. The complete fire alarm system shall be tested by the Division 26 Contractor as required by the Fire Marshal inspecting authority in the presence of the Owner's representative. Division 26 Contractor shall make all modifications as required by the Fire Marshal. Division 26 Contractor shall include in bid a second fire alarm system test of modifications made.
- C. Operate system for a minimum of seven (7) consecutive days with no trouble conditions before claiming contract completion.
- D. Complete and submit the required NFPA 72 test and inspection forms.

### 3.03 WARRANTY OF WORK

- A. The Division 26 Contractor shall warrant all materials, equipment and workmanship for a period of one (1) year from date of completion.

### 3.04 RECORD DRAWINGS

- A. Provide a set of drawings of the fire alarm system indicating the wiring and raceway system layout. Locate drawings next to the fire alarm control panel.

END OF SECTION