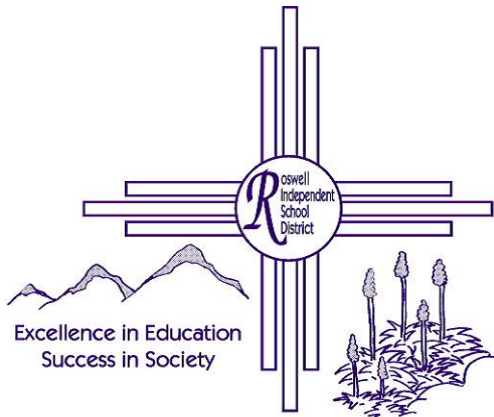


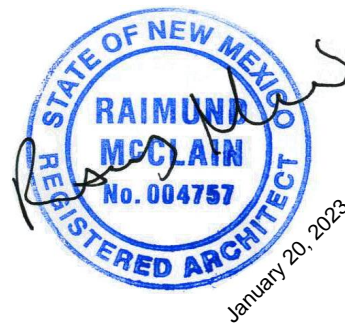
PROJECT MANUAL

VOLUME 2



ROSWELL INDEPENDENT
SCHOOL DISTRICT
AESC HVAC
UPGRADES

CONSTRUCTION
DOCUMENTS
SUBMITTAL



McCLAIN + YU
ARCHITECTURE & DESIGN

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SECTION 01 00 00 - GENERAL REQUIREMENTS

I.GENERAL

- I.1 HIERARCHY OF INFORMATION: Within the Drawings, if inconsistencies are found, written directions/instructions/notes take precedence over graphic illustrations; written dimensions over scaled; and large scale details over small scaled plans or sections; however, Contractor shall promptly bring to the Owner's and Architect's attention any discrepancies, inconsistencies, or ambiguities within the Drawings, or within the Contract Documents, prior to proceeding with the Work.
- I.2 GENERAL REQUIREMENT NOTES
- A. Paper copy of full-size updated drawings on a plan table shall be available on site for review by the architect and engineer. Reissued sheets shall be incorporated into this set on a weekly basis. Voided sheets shall be kept in the set and indicated as voided for reference.
 - B. Unless required by changes authorized by the architect, the third review of shop drawings (and thereafter) shall be billed hourly to the contractor by way of a deductive change order.
 - C. Any deviation in the Work at variance with the design intent shall be coordinated with the design professional. Written authorization from architect to proceed shall be required.
 - D. The Construction Documents including the Drawings and Project Manual shall constitute the primary point of reference for the Work. The Construction Team shall be familiar with and understand the Drawings and the Project Manual.
 - E. The Punchlist shall be provided by the Contractor prior to the Contractor's request of the architect's Punchlist.
 - F. Punchlist by the architect will be unaccompanied by the contractor.
 - G. Punchlist reinspection fee. If Punch List items require a third inspection (or beyond) the architect will bill the contractor on an hourly basis by way of a deductive change order.
 - H. The shop drawings do not supersede the Contract Documents. Shop drawing approval does not relieve the contractor of compliance with the Contract Documents. Quantities provided on the shop drawings are for the contractor's purposes and do not redefine the project scope. The shop drawings do not represent a means for circumventing the building code.
 - I. If a sequence of installation is implied in the Contract Documents then that sequence shall be followed – unless written approval is provided by the architect.

- J. All piping and conduit and other related building services items are assumed to be concealed in wall cavities. Any installation of exposed services must be approved by the architect in writing in advance of the installation.

II.PRODUCTS (Not Used)

III.EXECUTION (Not Used)

END OF SECTION 01 00 00

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Work covered by the Contract Documents.
 - 2. Type of the Contract.
 - 3. Work phases.
 - 4. Use of premises.
 - 5. Owner's occupancy requirements.
 - 6. Work restrictions.
 - 7. Specification formats and conventions.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: AESC HVAC UPGRADES
 - 1. Project Location: AESC Building 300 North Kentucky. Roswell NM 88201
- B. Owner: Roswell Independent School District
 - 1. Owner's Representative: Jeremy Sanchez RISD Construction Manager.
- C. Architect: McClain + Yu Architecture & Design 2010 Ridgecrest Dr. SE Albuquerque NM 87108
- D. Project Coordinator: Jeremy Sanchez RISD Construction Manager.
- A. The Work consists of the following: Selective demolition of existing HVAC equipment in the existing mechanical room and roof top units. The existing two pipe heating system is being converted to a four pipe heating and cooling system, with all the necessary equipment including condensing boiler(s) , chiller unit(s), piping, and fan coils units.
- B. Building modifications are limited interior modifications to accommodate the upgraded mechanical system, re-roofing and Additive Alternates for replacement of the exterior windows and existing exterior masonry repairs and refurbishment.

1.4 TYPE OF CONTRACT

- A. Project will be constructed under a Prime Contract.

1.5 WORK UNDER OTHER CONTRACTS

A. General:

1. Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.
2. The Owner may have additional work performed primarily on the infrastructure utilities, by other contractors or their own forces.

1.6 USE OF PREMISES

A. General: Contractor shall have full use of the defined premises for work of this Contract, including use of limited defined Project site. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

1. The Contractor's use of the building is limited to designated areas per the Sequence / Phasing plan. Included in the drawings.

1.7 OWNER'S OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: Owner will occupy the adjacent building areas and site and adjacent buildings, during the Contract period. Cooperate with Owner during the work to minimize conflicts and facilitate Owner usage of the adjacent building areas, site and adjacent buildings. Perform the Work so arranged with the Owner's representative.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. The Contractor's use of the building is limited to designated areas per the Sequence / Phasing plan. Included in the drawings.
3. **The site electrical service will be required to be upgraded that serves a portion of the building that will remain in service during the work of this contract. Coordinate revisions to the site electrical service with the Owner so as to minimize the down time and disruption to the portion of the building to remain occupied.**
4. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.8 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed inside the existing building and/or designated area of Work during normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except otherwise indicated.

1. Coordinate with RISD Construction Manager for extended work hours as needed.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect and Owner not less than five days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without the Owner's written permission.

1.9 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 33-division format and CSI/CSC's "Master Format" 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; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
 2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.
- 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 and meanings shall be interpreted as appropriate. 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.

1.10 MISCELLANEOUS PROVISIONS

- A. A background check is required for all construction personnel working on site. The background check shall be submitted to the district and approved by the district prior to entering the project site.
- B. Communication between construction personnel and school staff or students is prohibited. All communication with the district shall be directed to the RISD Construction Coordinator.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Abatement allowance.
- C. Related Requirements:
 - 1. Section 00 20 00 "Information Available To All Proposers" for Hazardous Materials
 - 2. Section 01 40 00 "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.4 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.7 LUMP-SUM and UNIT-COST ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 TESTING AND INSPECTING ALLOWANCES

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.9 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Lump Sum Allowance: Hazardous Material Removal Allowance: Include the sum of \$5,000.00 for Hazardous Materials removal of existing 12" x 12" Acoustical Tile Room 200, prior to new work in this space.

- B. Allowance No. 2: Lump Sum Allowance: General Electrical incidentals including: Re-lamping of existing light fixtures to remain as indicated on the drawings. Moving existing light switched and similar items Include the sum of \$25,000 for re-lamping of existing light fixtures.
- C. Allowance No.3: Lump Sum Allowance: Masonry repairs, wall brick and stone coping joints, as indicated on the drawings. Replacement of missing stone and precast coping pieces, as indicated on the drawings. Include the sum of \$60,000.00
- D. Unit Price Allowance No.1 – Provide an unit price allowance for additional coring of 12-inch thick concrete walls with a 6-inch hole. Include patching of final opening and sealing annular spaces.
- E. Unit Price Allowance No. 2 - Provide an unit price allowance for additional coring and saw cutting of 12-inch thick masonry walls for a 12” x 12” duct per the detail C6/A503. Include patching of final opening and sealing annular spaces.

END OF SECTION 01 21 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, cost of related coordination miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

1.5 PRODUCTS

(Not Used)

PART 2 - EXECUTION

2.1 SCHEDULE OF ALTERNATES

- A. Additive Alternate No. 1: Demolition/removal the existing windows of the New Replacement Windows as per the drawings and specifications. If this alternate is not accepted the Base Bid is for the existing windows to remain.

Additive Alternate No. 2: Not Used

Additive Alternate No.3: Quick Ship procurement of selected Electrical Gear (long lead items) as indicated by the drawings. If this alternate is not accepted the Base Bid is the procurement of the indicated items by standard procurement.

END OF SECTION 01 23 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
 - 1. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

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

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work using AIA Document G709 "Work Changes Proposal Request" that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and any Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 1) Do not include New Mexico Gross Receipts Tax as part of proposals.
 - c. Include costs of labor and supervision directly attributable to the change.
 - 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 Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - a. Do not include New Mexico Gross Receipts Tax as part of the request.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Owner initiated Proposal Request will use AIA Document G709 for Proposal Requests.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.
 - 3. Division 01 Section "Closeout Procedures".

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - c. Contractor's Construction Schedule.
 - d. Contract Closeout Activities and Procedures.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide sufficient line items to permit the Contractor to establish a basis for the billing of completed work and its revision by the Architect.
 - 1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Submit draft of AIA Document G703 Continuation Sheets.

3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Change Orders (numbers) that affect value.
 - d. Dollar value.
 - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
 - b. **Closeout Procedures Value:** As part of the Schedule of Values, include a Project Closeout Line Item of \$10,000 or 1% of the Construction Cost, whichever is greater for Project Closeout Activities. The Contractor shall not be paid any amount on this line item until **ALL** closeout items have been completed.
9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. When an application shows completion of an item, submit final or full waivers.
 2. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- G. Substantiating Data for Progress Payments:
1. Attach to the G703's a schedule of all materials stored on the site which are included thereon. This schedule should indicate the monthly status of those materials. The first time the materials appear on the schedule, one copy of the invoice, shipping ticket, or other substantiating document should be attached to the schedule.
 2. For sensitive materials which are not stored on the site for which the Contractor requests payment, the following procedure shall be precisely followed to request such approval. The Contractor shall submit a letter through the Architect to the Owner so that it is received by the Owner no later than the 20th of the month. The letter shall forward one copy of the invoice for the materials being considered and shall state the supplier, material, invoice number, and the amount. The letter shall be signed by a responsible officer of the Contractor stating that the following responsibilities are certified.
 - a. That material now stored in our warehouse will be installed on this project.
 - b. That it is covered by our insurance while so stored.
 - c. That it will be transported to the site.
 - d. That it is physically identified as property for this project.
 3. Those items for which Owner provides written approval may be included with that month's application for payment.
 4. As a prior condition for payment, the Contractor must comply with the following:
 - a. Demonstrate that the record drawing "as-builts" are being kept up to date.
 - b. Revise the project schedule to reflect the current state of completion.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of Values.
 3. Contractor's Construction Schedule (preliminary if not final).
 4. Submittals Schedule (preliminary if not final).
 5. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.

6. Initial progress report.
- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
 - 4. Requests for Interpretation or Information (RFIs).
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.
- C. Related Sections include the following:
 - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
 - 2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation, information or clarification of the Contract Documents.

1.4 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
- 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.
8. Startup and adjustment of systems.
9. 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. Refer to other Sections for disposition of construction waste and recycling requirements.

1.5 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings as limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate required installation sequences.
 - c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
2. Sheet Size: At least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (750 by 1000 mm).
3. Number of Copies: Submit three opaque copies of each submittal. Architect, will return one copy.
4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 5 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home 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 Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with other contractors.

1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

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

- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 10 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All 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. Tentative construction schedule.
- b. Phasing (if applicable).
- c. Critical work sequencing and long-lead items.
- d. Designation of key personnel and their duties.
- e. Procedures for processing field decisions and Change Orders.
- f. Procedures for RFIs.
- g. Procedures for testing and inspecting.
- h. Procedures for processing Applications for Payment.
- i. Distribution of the Contract Documents.
- j. Submittal procedures.
- k. Preparation of Record Documents.
- l. Use of the premises and existing building.
- m. Work restrictions.
- n. Owner's occupancy requirements.
- o. Responsibility for temporary facilities and controls.
- p. Construction waste management and recycling.

- q. Parking availability.
 - r. Office, work, and storage areas.
 - s. Equipment deliveries and priorities.
 - t. First aid.
 - u. Security.
 - v. Progress cleaning.
 - w. Working hours.
3. Minutes: Record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. The Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of 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 each activity 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.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, 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) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) RFIs.
 - 16) Status of proposal requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
 3. Minutes: Record the meeting minutes.
 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

- 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.
- E. Coordination Meetings: Conduct Project coordination meetings as required by the work and in advance of the work so as to not impact the schedule. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences. The Contractor is to conduct regular additional coordination meetings not attended by the Owner and Architect as required.
1. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the 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 coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined 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 Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, 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) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.8 REQUESTS FOR INTERPRETATION, INFORMATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
1. RFIs shall originate with General Contractor. The General Contractor shall maintain a log of RFI's and their status. RFIs submitted by entities other than General Contractor will be returned with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
1. Project name.
 2. Date.
 3. Name of Contractor.
 4. Name of Architect.
 5. RFI number, numbered sequentially.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 10. Contractor's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
 - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Hard-Copy RFIs: Submit Contractor's Project Management Software for review.
1. Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow a reasonable number of working days, but not less than seven days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.

- c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
1. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log at the weekly progress meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Preliminary Construction Schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Daily construction reports.
 - 4. Special reports.
- B. Related Sections include the following:
 - 1. Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
 - 2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
 - 3. Division 01 Section "Photographic Documentation" for submitting construction photographs.
 - 4. Division 01 Section "Submittal Procedures" for submitting schedules and reports.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Fagnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- H. Major Area: A story of construction, a separate building, or a similar significant construction element.
- I. Milestone: A key or critical point in time for reference or measurement.
- J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
- K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

- A. Preliminary Construction Schedule: Submit two opaque copies.
- B. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
- C. Daily Construction Reports: Maintain complete and accurate Daily Construction Reports for submittal upon request.
- D. Special Reports: Submit two copies at time of unusual event.

1.5 QUALITY ASSURANCE

- A. Scheduling Qualifications: A person experienced in scheduling and reporting for projects of a similar size and scope. Schedules and Reports must be submitted within 3 days of a requested update.

1.6 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from parties involved.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 4. Startup and Testing Time: Include not less than 15 work days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase, if applicable.
 2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Uninterruptible services.
 - b. Partial occupancy before Substantial Completion.
 - c. Use of premises restrictions.
 - d. Seasonal variations.
 - e. Environmental control.
 - f. Curing.
 - g. Startup and placement into final use and operation.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

2.2 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.

- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work.

2.3 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site (if applicable).
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions.
 - 7. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (refer to special reports).
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Meter readings and similar recordings.
 - 12. Emergency procedures.
 - 13. Orders and requests of authorities having jurisdiction.
 - 14. Change Orders received and implemented.
 - 15. Construction Change Directives received and implemented.
 - 16. Services connected and disconnected.
 - 17. Equipment or system tests and startups.
 - 18. Partial Completions and occupancies.
 - 19. Substantial Completions authorized.

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using scheduling.
 - 1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in scheduling and reporting techniques. Submit qualifications.

- B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before the regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

- C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations.

END OF SECTION 01 32 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs as a construction aide.
- B. Construction Aid Photographs: Digital photos of construction issues suitable for e-mailing to the Architect. Limit resolution and file size to allow for e-mailing.
- C. Related Sections include the following:
 - 1. Division 01 Section "Submittal Procedures" for submitting photographic documentation.
 - 2. Division 01 Section "Temporary Facilities and Controls" for telephone/data services for e-mailing photos from the construction site as a "Construction Aid".
 - 3. Division 02 Section "Selective Structure Demolition" for documentation of existing conditions prior to the start of work.

1.3 SUBMITTALS

- A. Pre-Construction Photographs: Photographs and or videos (2 copies each) of existing adjacent buildings and site conditions that could be later construed as damage caused by the demolition and construction activities.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in uncompressed TIFF format, produced by a digital camera with minimum sensor size of 4.0 megapixels, and at an image resolution of not less than 1024 by 768 pixels.
 - 1. Upon agreement digital images smaller than 4 mega pixel minimum suitable for convenient e-mailing will be acceptable.
- B. Video Images: Provide videos for playback on generally available equipment in DVD media.

PART 3 - EXECUTION

- A. Preconstruction Photographs: Before starting construction], take color, digital photographs and/or videos of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.

1. Flag construction limits before taking construction photographs.
 2. Take as many as required photographs to show existing conditions adjacent to property before starting the Work.
 3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- B. Construction Aid Photographs: As the need arises with questions on how to proceed in the field, take digital photographs of conditions to be resolved for e-mailing to the Architect.

END OF SECTION 01 32 33

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections include the following:
 - 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
 - 2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
 - 3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
 - 4. Division 01 Section "Photographic Documentation" for submitting construction photographs.
 - 5. Division 01 Section "Quality Requirements" for submitting test and inspection reports.
 - 6. Division 01 Section "Closeout Procedures" for submitting warranties.
 - 7. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 8. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 9. Divisions 02 through 49 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.
 - 1. At the request of the Contractor and approval of the Owner, CAD drawing files may be obtained upon signing of requested release forms controlling the use of these files for specific use in the Work of this project. Request to provide files in a "software release versions" other than the version they were drawn in may be subject to cost charges for the time required to make such changes and any special administrative handling cost.

- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received for example, submittals requiring a color selection to be coordinated with other required color selections.
- C. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow fifteen working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow fifteen working days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow twenty-one working days for initial review of each submittal.
- E. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately three by four inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use the Specification Section number followed by a decimal point and then a sequential number (e.g.,06 10 00.01).

Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06 10 00.01.R1).

- i. Other necessary identification.
- F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
 2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
1. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Specification Section number and title.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
- J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- K. Use for Construction: Use only final submittals with mark indicating "Approved or Furnish as Corrected" taken by Architect.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Wiring diagrams showing factory-installed wiring.
 - f. Printed performance curves.
 - g. Compliance with specified referenced standards.
 - h. Testing by recognized testing agency.
 - i. Notation of coordination requirements.
 4. Submit Product Data before or concurrent with Samples.
 5. Number of Copies: Submit number established at Preconstruction Conference agreement but no less than four copies of Product Data, unless otherwise indicated. Architect will return one (minimum) copy. Mark up and retain one returned copy as a Project Record Document.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Architect's CAD Drawings are otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Templates and patterns.
 - g. Schedules.
 - h. Design calculations (if required by specification).
 - i. Relationship to adjoining construction clearly indicated.
 - j. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
 3. Number of Copies: Submit four (minimum) opaque (bond) copies of each submittal. Architect will return one copy.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Sample source.
 - b. Number and title of appropriate Specification Section.
 3. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 4. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample sets; remainder will be returned.
- E. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation" for Construction Manager's action.
- F. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, and telephone number of entity performing subcontract or supplying products.
 2. Number and title of related Specification Section(s) covered by subcontract.
- 2.2 INFORMATIONAL SUBMITTALS
- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.

2. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
 - B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
 - C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
 - D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
 - E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
 - F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 - G. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
 - H. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 1. Preparation of substrates.
 2. Required substrate tolerances.
 3. Sequence of installation or erection.
 4. Required installation tolerances.
 5. Required adjustments.
 6. Recommendations for cleaning and protection.
 - I. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
 - J. Construction Photographs: Comply with requirements specified in Division 01 Section "Photographic Documentation."
- 2.3 DELEGATED DESIGN
- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S / ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - 1. **Approved**; no further action required; **Furnish as Corrected**, Make noted changes/corrections and proceed; **Rejected**, Note any comments and resubmit; **Revise and Resubmit**, Revise per comments and resubmit; **Submit Specified Item**, Revise and resubmit with specified item/manufacturer; **See Attached Comments**, Comments are attached from Architect or others with information for further action or disposition of submittal.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Testing indicated to be provided by the Owner or their designated representative will require the Contractor to provide access, support services required by the specific testing; and the time and cooperation of Contract personnel as may be required for successful test to be carried out.
- C. Related Sections include the following:
 - 1. Division 01 Section "Allowances" for additional Hazardous Material Testing
 - 2. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
 - 3. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
 - 4. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing,

or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

- C. 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.
- D. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- E. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- 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. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Recommendations on retesting and re-inspecting.

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.

1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. 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.
- C. 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, as well as sufficient production capacity to produce required units.
- D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.
- F. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- G. 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.
- H. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 3. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
- C. 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 as specified in Division 01 Section "Submittal Procedures."
- D. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. 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.
- F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, security and protection facilities, including dust control and requirements for the provision of remote parking and transportation to and from the site.
- B. Related Sections include the following:
 - 1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
 - 2. Division 01 Section "Execution" for progress cleaning requirements.
 - 3. Division 01 Section "Construction Waste Management" for procedures for collection sorting of Construction Waste
 - 4. Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum.
 - 1. Where Owner Utilities are available, they may be used. Water and electrical utilities are available. All temporary connections are to be approved by RISD and restored to the original condition at the completion of the work.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch (50-mm) galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts.

2.2 TEMPORARY FACILITIES

- A. Temporary Dust Control Partitions: Partitions and or barriers sufficient to prevent migration of

Dust beyond the construction work areas.

- B. Temporary filters placed on all existing Return Air openings to prevent dust from entering the Mechanical System. MERV 8 unless higher rating is required by activity being performed.
- C. Temporary Storm Water Pollution Prevention Plan (SWPPP) features/structures as may be required.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
- C. Waste and Recycling Containers: As required.

2.4 Project Identification Sign: Contractor's Project Identification Sign size and location to be coordinated with Owner Representative.

2.5 CONTRACTOR PARKING: Due to limited parking, Contractor parking will be limited to an area designated by the RISD Construction Manager/Director. Additional parking as required will be remote from the Site and is the Contractor's responsibility.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, and Owner, for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Use of Owner's water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- D. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity.

1. Upon approval of the Owner use of existing HVAC Equipment may be used with the installation of new filters prior to the start of construction and again at the conclusion of the work.

- E. Electric Power Service: Use of Owner's electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.
- F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
- G. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel.
 - 1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine and computer in the field office.
 - 2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- H. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
 - 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Project Identification and Temporary Signs: Provide Project identification and other signs. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
 - 1. Provide Project Identification Sign: 4 feet x 8 feet, wood frame, exterior grade plywood construction. Sign shall be painted by professional sign painter. Exhibit lettering to Architect's design and colors. Sign shall list title of Project, contact at Owner, Architect, and Contractor.
 - 2. Erect on site at location established by the Owner.
- C. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

- B. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion.
- C. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As indicated on the drawings and to be coordinated with RISD Construction Manager.
- D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- E. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

3.5 RISD UTILITIES, WATER SECTION POLICIES AND REQUIREMENTS

- A. Temporary domestic water service to construction sites: In order to protect the health of the domestic water system, PPD utilities must be contacted and authorization must be given prior to any connection being made to the domestic water system
- B. Fire Hydrants Connections:
 - 1. Requirements for temporary services attached to a fire hydrant.
 - a. Equipment Requirements:
 - b. Backflow prevention Device: A reduced pressure backflow unit is the only authorized backflow prevention device.
 - c. An isolating gate valve attached to the backflow prevention device.
 - 2. Policy Procedures:
 - a. A short, hands-on training on how to properly operate a fire hydrant.
 - b. This training has to be set up with RISD utilities personnel .
- C. Any other direct connection to RISD distribution system: The minimum equipment requirement is as follows:
 - 1. Equipment requirements:
 - 2. Backflow prevention device: A reduced pressure backflow unit is the only authorized backflow prevention device.
 - 3. An isolating gate valve attached to the backflow prevention device.

END OF SECTION 01 50 00

SECTION 01 60 00 – PRODUCT REQUIREMENTS

PART 1 - GENERAL

- 1.1 DESCRIPTION: Material and equipment incorporated into the Work shall conform to applicable specifications and standards, and shall comply with size, make, type, and quality specified, or as specifically approved in writing by Architect.
- A. Manufactured and Fabricated Products
1. Design, fabricate, and assemble in accord with the best engineering and shop practices.
 2. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
 3. Two or more items of the same kind shall be identical, by the same manufacturer.
 4. Products shall be suitable for service condition.
 5. Equipment capacities, sizes, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
- B. Do not use material or equipment for any purpose other than that for which it is designed or is specified.
- C. It is the intention of the Section to provide the requirements to be met by all fasteners and anchoring devices which are generally exposed to view.
1. Items which are permanently installed and which will not require adjustment shall be anchored with one-way screws. If both faces of the items are exposed the fastener shall be a sex bolt with one-way heads. Machine bolts and nuts may be used only if the threads are upset or the head of the bolt is welded to the item.
 2. Items which are required to be removed periodically shall have anchoring devices with spanner heads or hexagonal socket heads.
 3. Phillips head screws shall be used only for the anchoring of finish hardware such as butts, locksets, etc. No slotted head screws shall be used in any exposed fastening.
 4. The requirements of this section of the specifications apply to fasteners & anchoring devices of electrical and mechanical items which are exposed to view in public spaces.
- 1.2 MANUFACTURER'S INSTRUCTIONS
- A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to the Architect.
1. Maintain one set of complete instructions at the job site during installation and until completion. At the completion of the work, incorporate the instructions into the Operations and Maintenance manual.
- B. Handle, install, connect, clean, condition, and adjust products in strict accordance with such instructions and in conformity with specified requirements.
1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Architect for further instructions.

2. Do not proceed with work without clear instruction.

C. Perform work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.3 TRANSPORTATION AND HANDLING

A. Arrange deliveries of products in accordance with construction schedules, coordinate to avoid conflict with work and conditions at the site.

1. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals and that products are properly protected and undamaged.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

1.4 STORAGE AND PROTECTION

A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Maintain temperature and humidity within the ranges required by manufacturer's instructions. Arrange storage in a manner to provide easy access for inspection and make periodic inspections of store products to assure that products are maintained under specified conditions, and free from damage or deterioration.

B. Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01 63 00 - SUBSTITUTIONS AND PRODUCT OPTIONS

PART 1 - GENERAL

1.1 PRODUCT OPTIONS:

- A. Substitutions: No substitutions will be considered unless a written request for approval has been submitted in accordance with the requirements as stated in the Instructions to Bidders, approved by Addendum.
 - 1. Form for written request is attached to this section and may be copied.
- B. Products List: Within 30 days after Contract Date, submit to Architect a complete list of major products proposed to be used, with the name of the manufacturer and the installing subcontractor.
- C. Contractor's Options:
 - 1. For products specified only by reference standard, select any product meeting that standard.
 - 2. For products specified by naming several products or manufacturers, select any one of the products or manufacturers named which complies with the specifications.
 - 3. For products specified by naming one or more products or manufacturers and "or equal" "approved equal" or "prior approved equal". Contractor must submit a written request for any product or manufacturer not specifically named in accordance with Instructions to Bidders.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

SUBSTITUTION REQUEST FORM

TO: _____

PROJECT: RISD Administration & Educational Services Center HVAC Upgrades

We hereby submit for your consideration the following product instead of the specified item for the above project:

<u>Section</u>	<u>Page</u>	<u>Paragraph/Line</u>	<u>Specified Item</u>
_____	_____	_____	_____

Proposed Substitution: _____

Attach complete product description, samples, photographs, performance and text data, warranty information, and other information necessary for evaluation. Identify specific model numbers, finishes, options, etc.

A. Will changes be required to building design in order to properly install proposed substitution?
Yes _____ No _____ If Yes, explain

B. Will the undersigned pay for changes to the building design, including engineering and drawings costs, caused by requested substitution?
Yes _____ No _____

C. List the differences between proposed substitution and specified item.

<u>Specified Item</u>	<u>Proposed Substitution</u>
_____	_____
_____	_____

D. Does substitution affect Drawing dimensions?
Yes _____ No _____

E. What affect does substitution have on other trades?

F. Does manufacturer's warrantee of the proposed substitution differ from that specified?

Yes _____ No _____ If Yes, explain _____

G. Will substitution effect progress schedule?

Yes _____ No _____ If Yes, explain _____

H. Will substitution require more license fees or royalties than specified product?

Yes _____ No _____ If Yes, explain _____

I. Will maintenance and service parts be locally available for substitution?

Yes _____ No _____ If Yes, identify City name and State _____ If No, explain _____

J. Will change in product effect outcome of LEED points?

Yes N/A_ No_N/A_ If Yes, explain _____

Submitted by:

Signature

Firm

Address

For Architect's Use Only:
___ Submit Specified Item
___ No Exceptions Taken
___ Note Markings
___ Revise and Resubmit

___ Received Too Late
___ Rejected
___ Comments Attached

By: _____

Date: _____

Date _____ Remarks: _____

Telephone _____ Fax _____

END OF SECTION

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

- B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 01 Section "Submittal Procedures" for submitting surveys.
3. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
4. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
 1. Provide survey documentation as required for all final approvals of authorities having jurisdiction.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Before construction, verify the location and points of connection of utility services.
 - B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, and water-service piping; and underground electrical services.
 - C. Acceptance of Conditions: 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. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.
- 3.2 PREPARATION
- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- 3.3 CONSTRUCTION LAYOUT
- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
 - B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- 3.4 FIELD ENGINEERING
- A. Identification: Owner will identify existing benchmarks, control points.
 - B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
- 3.5 INSTALLATION
- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

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

B. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.

3.6 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. **Do not let dust migrate from the work area.** Dispose of materials lawfully.

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. 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.

E. Waste Disposal: Burying or burning waste materials on-site will not be permitted.

3.7 STARTING AND ADJUSTING

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

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 Division 01 Section "Quality Requirements."

3.8 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.

3.9 CORRECTION OF THE WORK

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

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

END OF SECTION 01 73 00

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Divisions 02 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
 - 1. 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 that results in increased maintenance or decreased operational life or safety.
- B. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

3.3 PERFORMANCE

- A. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
- B. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

END OF SECTION 01 73 29

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Sections include the following:
 - 1. Division 01 Section "Close Out Procedures"
Division 01 Section "Temporary Facilities and Controls" for environmental-protection measures during construction, and location of waste containers at Project site.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

- A. Salvage/Recycle Requirements: Owner's goal is to salvage and recycle as much nonhazardous demolition and construction waste as possible including the following materials:
 - 1. Demolition Waste:
 - a. Concrete.

- b. Concrete reinforcing steel.
- c. Concrete masonry units.
- d. Structural and miscellaneous steel.
- e. Equipment.
- f. Piping.
- g. Supports and hangers.
- h. Valves.
- i. Mechanical equipment.
- j. Refrigerants.
- k. Electrical conduit.
- l. Copper wiring.
- m. Lighting fixtures.
- n. Lamps.
- o. Ballasts.
- p. Electrical devices.
- q. Switchgear and panelboards.
- r. Transformers.

2. Construction Waste:

- a. Site-clearing waste.
- b. Masonry and CMU.
- c. Lumber.
- d. Wood sheet materials.
- e. Wood trim.
- f. Metals.
- g. Roofing.
- h. Insulation.
- i. Carpet tiles.
- j. Gypsum board.
- k. Piping.
- l. Electrical conduit.
- m. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Plastic pails.

1.5 SUBMITTALS

- A. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- B. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

- C. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement waste management plan as approved by Architect. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Sale and Donation: Not permitted on Project site.
- B. Salvaged Items for Owner's Use:
 - 1. Clean salvaged items.
 - 2. Store items in a secure area until delivery to Owner.
 - 3. Transport items to Owner's storage area designated by Owner.
 - 4. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the following:
 - 1. NM Recycling Resource Guide, www.recyclenewmexico.com or 505-983-4470.

- B. **Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.**
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION/CONSTRUCTION WASTE

- A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum 4-inch size.
- B. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, painted wood, and treated wood materials.
- C. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- D. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- E. Lighting Fixtures: Separate lamps by type and protect from breakage. Dispose of at approved disposal/recycle provider.
- F. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.
- G. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.

3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 01 74 19

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
1. Inspection procedures.
 2. Warranties.
 3. Final cleaning.
- B. Related Sections include the following:
1. Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
 2. Division 01 Section "Execution" for progress cleaning of Project site.
 3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 4. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 5. Division 01 Section "Construction Waste Management and Disposal" for project waste reduction calculations.
 6. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 4. Prepare and submit Project Record Documents, operation and maintenance manuals, property surveys, and similar final record information.
 5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner.
 6. Complete final cleaning requirements, including touchup painting.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection

or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Reinspection Fees: Should the status of the Work require re-observation by the Architect due to failure of the Work to comply with the Contractor's claims on initial observation the Owner will deduct the amount of the Architect's compensation for reinspection services from the final payment to the Contractor.

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
 1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect.
 3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit two copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction.
 1. Organize list of spaces in sequential order, starting with exterior areas first and 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. Product Name
 - b. Date of Issue
 - c. Name of Contractor

1.6 WARRANTIES

- A. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 1. Include Warranties as part of Operation and Maintenance Submittal.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove snow and ice to provide safe access to building.
 - e. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - f. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - g. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - h. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - 1) Exterior items exposed to view are to be field painted to coordinate with the building exterior color scheme.
 - i. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - j. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - k. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Maintenance manuals for the care and maintenance of products, materials, and finishes systems and equipment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
 - 3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
 - 4. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 SUBMITTALS

- A. Initial Submittal: Submit three copies of each manual at least 21 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return review and if required return to Contractor for inclusion of additional materials and corrections as required.
- B. Operation and Maintenance Manual must be complete and available for Owners use prior to conducting any Testing and Demonstration activities.

1.4 COORDINATION

- A. Where operation and maintenance documentation include information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
 - 1. List of systems.
 - 2. List of equipment.
 - 3. Table of contents.

- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each operation, and maintenance manual.

2.2 MANUALS, GENERAL

- A. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment.
 - 1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 - 4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions.
 - 2. Operating standards.
 - 3. Operating procedures.
 - 4. Operating logs.
 - 5. Wiring diagrams.
 - 6. Control diagrams.
 - 7. Piped system diagrams.
 - 8. Precautions against improper use.
 - 9. License requirements including inspection and renewal dates.
- B. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Normal shutdown instructions.
 - 7. Seasonal and weekend operating instructions.

8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

- C. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- D. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Product Information: Include the following, as applicable:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture (if applicable).
 4. Reordering information for specially manufactured products.
- C. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- D. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- E. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 1. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents.
- C. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
- B. Related Sections include the following:
 - 1. Division 01 Section "Payment Procedures" for maintaining Project Record Prints as a monthly requirement prior to payment.
 - 2. Division 01 Section "Closeout Procedures" for general closeout procedures.
 - 3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 4. Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up Record Prints.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of black-line white prints of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.

- d. Locations and depths of underground utilities.
- e. Revisions to routing of piping and conduits.
- f. Revisions to electrical circuitry.
- g. Actual equipment locations.
- h. Duct size and routing.
- i. Locations of concealed internal utilities.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

- 1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

- 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
- 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training DVD's.
- B. Related Sections include the following:
 - 1. Division 01 Section "Project Management and Coordination" for requirements for pre-instruction conferences.
 - 2. Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

- A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. At completion of training, submit one complete training manual(s) for Owner's use.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
 - 1. Use form provided at the end of this Sections
- C. Demonstration and Training Videos: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date video was recorded.

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

1. Requirement can be waived with Approval of Architect and Owner based on Contractor experience in training Owner's personnel.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate content of training modules with content of approved operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
 1. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project Record Documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 2. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 3. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.

- k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 4. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
 - 5. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
 - 6. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
 - 7. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

3.3 DEMONSTRATION AND TRAINING VIDEOS

- A. General: Engage a qualified commercial photographer to record demonstration and training videos. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video Format: Provide high-quality VHS color videotape in full-size cassettes or DVD recording as agreed upon with Owner for Owner's play back equipment.

DOCUMENTATION OF TRAINING

DATE:

TIME:

ATTENDEES:

This is to acknowledge that _____, (trainer) provided instruction to the RISD Facilities Management (trainees) on the routine adjustments and maintenance of the _____ for proper operation.

SIGNATURE OF TRAINER:

DATE

SIGNATURE OF TRAINEES:

DATE _____

DATE _____

DATE _____

DATE _____

DATE _____

DATE _____

DATE _____

cc: Owner:
Contractor:
Architect: McClain + Yu

END OF SECTION 01 79 00

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected interior and exterior elements to accommodate new HVAC Upgrade work.
- B. Related Sections include the following:
 - 1. Division 01 Section "Information Available to All Proposers" for Hazardous Material Survey Information.
 - 2. Division 1 Section "Summary" for use of premises and Owner-occupancy requirements.
 - 3. Division 01 Section "Photographic Documentation" for preconstruction photographs taken before selective demolition operations.
 - 4. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
 - 5. Division 01 Section "Construction Waste Management and Disposal" for disposal of demolished materials.
 - 6. Division 07 Section "Preparation for Reroofing" for removal of existing roofing, mechanical equipment and ductwork and electrical.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.
 - 1. Salvage/Recycle removed items.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. 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.

1.4 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.5 SUBMITTALS

- A. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- B. Pre-demolition Photographs or DVD's: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by Selective Demolition operations. Comply with Division 01 Section "Photographic Documentation." Submit before Work begins.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI A10.6 and NFPA 241.

1.7 PROJECT CONDITIONS

- A. Owner will occupy portions of buildings and site immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. Reports on the presence of hazardous materials are in Section 00 20 00 Information Available to All Bidders for review and use. Examine reports to become aware of locations where hazardous materials are present.
 - 1. Separate, store and dispose of all hazardous materials and toxic waste in accordance with local and EPA regulations and additional criteria listed below.
 - a. Disposal of fluorescent light tubes in open containers is not permitted.
 - b. Disposal of ballast and other building elements containing PCB's in open containers is not permitted.
 - c. Disposal of building elements containing mercury in open containers is not permitted.
 - 2. Do not disturb previously unidentified hazardous materials or items suspected of containing hazardous materials except under procedures established by the Authority Having Jurisdiction.
- E. Storage or sale of removed items or materials on-site is not permitted.

Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.
2. Provide a Fire Watch for any cutting torch and or welding operations with an open flame.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. 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.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs and/or preconstruction DVD's.
 1. Comply with requirements specified in Division 01 Section "Photographic Documentation."

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 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 services/systems to other parts of the Campus / building

3.3 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. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- 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 adjacent buildings
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of soils containing adjacent buildings and utilities to remain.

3.4 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. 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. Temporarily cover openings to remain.
 2. 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.
 3. Maintain adequate ventilation when using cutting torches.
 4. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal."
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete / Reinforced Concrete Masonry: Demolish in small sections. Cut concrete full depth of at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition.

3.6 DISPOSAL 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 in an EPA-approved landfill.
 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. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
 - B. Burning: Do not burn demolished materials.
 - C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.
- 3.7 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 02 41 19

SECTION 03 10 00 - CONCRETE FORMWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDED

- A. This section includes formwork for cast-in-place concrete, including installation of embedded items.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 03 Section "Concrete Reinforcement"
- B. Division 03 Section "Cast-In-Place Concrete"

1.3 QUALITY ASSURANCE

- A. Comply with the requirements of Chapter 4 of the American Concrete Institute "Specifications for Structural Concrete for Buildings", ACI 301-89.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. D 226-89 Asphalt - Saturated Organic Felt used in Roofing and Waterproofing"
 - 2. D 1751-83 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Forms for Exposed Finish Concrete: Plywood complying with U.S. Product Standard PS-1-83 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better or metal, metal-framed plywood or other acceptable panel-type materials. Plywood shall be mill-oiled and edge-sealed, with each piece bearing legible inspection trademark. Furnish in largest practicable sizes to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- B. Forms for Unexposed Finish Concrete: Use plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- C. Chamfer Strips: $\frac{3}{4}$ inch by $\frac{3}{4}$ inch wood, PVC, or rubber.
- D. Preformed Construction Joint: 24-gage steel, galvanized, shaped to form a continuous tongue and groove key.
- E. Expansion Joint Material: Asphalt saturated fiberboard, $\frac{1}{2}$ inch thick, meeting the requirements of ASTM D 1751.

- F. Felt: Asphalt-saturated organic felt, weighing 30 pounds per 100 square feet, meeting the requirements of ASTM D 226.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel. Set screeds accurately. Embedded items shall be accurately aligned and adequately supported. Verify installation of mechanical, plumbing, and electrical items to be embedded in concrete. Correct any unsatisfactory condition before proceeding further.
- B. Verify all form coating and form products are compatible with crystalline waterproofing.

3.2 PREPARATION

- A. Form Coating: Coat contact surfaces of forms with a form coating compound before reinforcement is placed. Thin form-coating compounds with thinning agent and apply as specified in manufacturer's instructions. Do not allow excess form-coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed.

3.3 INSTALLATION

- A. Formwork: Formwork shall support vertical and lateral loads that are applied until such loads can be supported by concrete structure. Formwork shall be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials. Construct forms to sizes, shapes, lines and dimensions shown. Perform surveys to obtain accurate alignment. Provide for recesses, chamfers, blocking, anchorages, inserts, and other features required in work. Select materials to obtain required finishes. Butt joints solidly and provide backup at joints to prevent leakage of cement paste.
- C. Chamfer Strips(where indicated by details): Provide at exposed corners and edges.
- D. Form Ties: Use factory fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.
- E. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris before concrete is placed. Retighten forms and bracing after concrete placement as required to eliminate mortar leaks and maintain proper alignment.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set anchorage devices and other embedded items accurately. Use setting drawings, diagrams, templates and printed instructions provided by supplier. Secure embedded items such that they are not displaced during placement of concrete.

3.5 JOINTS

- A. Construction Joints: Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure. Place construction joints perpendicular

to the main reinforcement. Continue reinforcement across construction joints unless noted otherwise.

- B. Keyways: Provide keyways at least 1-½ inch deep in construction joints in walls and slabs.
- C. Preformed Construction Joint For Slabs on Grade: Secure with galvanized steel stakes, 1/8 inch thick by 1-1/8 inches wide with ½ inch deep rib and tapered point. Splice adjoining joints with 24 gage steel, galvanized splice plates.
- D. Isolation Joints in Slabs on Grade: Construct isolation joints in interior slabs using 30 lb. felt. Provide isolation joints at points of contact between slabs on grade and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated. Construct isolation joints on exterior slabs abutting vertical surfaces with ½ inch thick expansion joint material.
- F. Control Joints in Slabs-on-Grade:
 - 1. Preformed Strip: Insert premolded rigid plastic, or metal strip into fresh concrete. Cut groove for strip using 10-foot long straight edge cutting tool. Depths of strip shall be one fourth of slab thickness. Press strip into groove such that top of strip is level with the concrete surface. Pull off removable top section, if any, prior to troweling.
 - 2. Saw Cut: Contractor may saw cut control joints instead of using preformed strips. Saw cut joints shall be 1/8 inch wide. Saw cut depth should equal 1/3 of slab depth. Cut joints after concrete has hardened sufficiently to prevent raveling; usually 4 to 12 hours after slab has been cast and finished. Use diamond or silicone-carbide blades.

3.6 REMOVAL OF FORMWORK

- A. General: Prevent excessive deflection, distortion, and damage to concrete when forms are stripped. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.

END OF SECTION

SECTION 03 20 00 – CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. This section includes fabrication and installation of deformed bar and welded wire fabric reinforcing steel.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 03 Section “Cast In Place Concrete”

1.3 QUALITY ASSURANCE

- A. Reference Standards

- 1. American Concrete Institute (ACI) Standards

- a. 301-10 Specifications for Structural Concrete for Buildings
- b. SP-66 Detailing Manual
- c. 318-08 Building Code Requirements for Reinforced Concrete

- 2. American Society for Testing and Materials (ASTM), Standard Specifications

- a. A 82-02 Steel Wire, Plain, for Concrete Reinforcement
- b. A 185-02 Steel Welded Steel Wire Fabric, Plain, for Concrete Reinforcement
- c. A 615-04b Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

- 3. Concrete Reinforcing Steel Institute (CRSI)

- a. Manual of Standard Practice – 28th Edition

1.4 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for reinforcing steel. Comply with ACI 315 requirements showing layout, bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of reinforcing steel.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60. Stirrups and ties shall be Grade 40.
- B. Welded Wire Fabric: ASTM A 185, flat sheets
- C. Steel Wire: ASTM A 82, plain, cold-drawn steel, 16 gauge.

Supports for Reinforcing Steel: Wire bar type and precast concrete block type meeting the requirements of CRSI Manual of Standard Practice.

2.2 FABRICATION

- A. Fabricate reinforcing steel in accordance with fabricating tolerances in ACI SP-66.
- B. Do not fabricate reinforcing steel until shop drawings are approved.

PART 3 – EXECUTION

3.1 PLACING BAR SUPPORTS

- A. General: Provide bar supports meeting the requirements of the CRSI Specification for Placing Bar supports.
- B. Slabs-on-grade: Use supports with sand plates or precast concrete blocks or horizontal runners where base material will not support chair legs.

3.2 PLACING REINFORCING STEEL

- A. General: Comply with CRSI Code of Standard Practice for "Placing Reinforcing Bars".
- B. Clean reinforcing steel of loose rust and mill scale, earth, ice, and other materials, which reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcing steel against displacement by formwork, construction, or concrete placement operations. Place reinforcing steel to obtain minimum coverages. Arrange, space, and securely tie bars and bar supports to hold reinforcing steel in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- D. Concrete Cover: Provide the following cover unless noted otherwise on the Drawings:
 - 1. Concrete cast against and permanently exposed to earth: 3 inch
 - 2. Concrete exposed to earth or weather:
 - a. Bars larger than No. 5 : 2 inch
 - b. Bars No.5 or smaller: 1-1/2 inch
- E. Rebar Splices: Locate at points of minimum stress or as shown on contract drawings. Unless noted otherwise, provide lap splices 30 bar diameters or 18 inches minimum length.
- F. Welded Wire Fabric Splices: Lap one complete wire spacing.
- G. Corner Reinforcing: Provide corner bars of same size and spacing as horizontal reinforcing steel. Lap with horizontal reinforcing 30 bar diameters or 18 inches minimum length.
- H. Reinforcing at Construction/Control Joints: Discontinue reinforcing steel 2 inches from preformed construction joints in slabs-on-grade. Cut alternate longitudinal bars at weakened plane control joints in walls.
- I. Do not weld reinforcing.

END OF SECTION

SECTION 03 30 00 – CAST IN PLACE CONCRETE

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. This section covers cast-in-place concrete including finishing, surface repair and curing.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 03 Section “Concrete Formwork”.
- B. Division 03 Section “Concrete Reinforcement”.
- C. Division 32 Section “Concrete Paving”.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Meet the requirements of the following codes, specifications and standards.
 - 1. American Concrete Institute (ACI)
 - a. ACI 301-02 Specifications for Structural Concrete for Buildings
 - b. ACI 306-90 Standard Specification for Cold Weather Concreting
 - c. ACI 318-02 Building Code Requirements for Structural Concrete
 - 2. ASTM International
 - a. ASTM C 31/
C 31M-03a Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - b. ASTM C 33-03 Standard Specification for Concrete Aggregates
 - c. ASTM C 39/
C 39M-05 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - d. ASTM C 94/
C 94M-05 Standard Specification for Ready-Mixed Concrete
 - e. ASTM C 131-03 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - f. ASTM C 136-06 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - g. ASTM C 143
C 143M-05a Standard Test Method for Slump of Hydraulic Cement Concrete

- h. ASTM C 150-05 Standard Specification for Portland Cement
- i. ASTM C 171-03 Standard Specification for Sheet Materials for Curing Concrete
- j. ASTM C 172-04 Standard Practice for Sampling Freshly Mixed Concrete
- k. ASTM C 173/
C 173M-91 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- l. ASTM C 231-04 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- m. ASTM C 260-01 Standard Specification for Air Entraining Admixtures for Concrete
- n. ASTM C 309-03 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- o. ASTM C 330-05 Standard Specification for Lightweight Aggregates for Structural Concrete
- p. ASTM C 494/
C 494M-05a Standard Specification for Chemical Admixtures for Concrete
- q. ASTM C 567-05a Standard Test Method for Determining Density of Structural Lightweight Concrete
- r. ASTM C 618-05 Standard Specification for Coal Fly Ash and Raw or Calcined natural Pozzolan for Use in Concrete
- s. ASTM D 4318-05 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and admixtures.
- C. Concrete Mix Design:
 - 1. Submit mix design in accordance with ACI-301, Section 3.
 - 2. Submit with mix design results of laboratory tests performed within previous 6 months indicating aggregates from the proposed source comply with the requirements of ASTM C 33 or C 330 as applicable.
 - 3. Submit the proposed area of use for each mix design submitted (footings, slabs, walls, paving, etc.).

- D. Test Reports: Submit copies of test reports for concrete compressive strength, air content, temperature and slump.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Portland Cement: ASTM C 150, Type I / II. Use one brand of cement throughout project.
- B. Normal Weight Aggregates: ASTM C 33. Provide aggregates from a single source for exposed concrete.
- C. Light Weight Aggregates: ASTM C 330.
- D. Water: Potable.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Water Reducing Admixture: ASTM C 494.
- G. Fly-Ash: ASTM C 618, Class F.
- H. Moisture-Retaining Cover: Provide waterproof paper, polyethylene film, or polyethylene-coated burlap meeting the requirements of ASTM C 171.
- I. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound meeting the requirements of ASTM C 309; Type 1-D with fugitive dye for interior concrete and foundations; Type 2, white pigmented, for exposed exterior concrete except exposed exterior Architectural concrete, use Type 1-D.
- J. Granular base shall meet the following grading requirements when tested in accordance with ASTM C 136.

Sieve Size (Square Openings)	Percent Passing by Weight
1 inch	100
¾ inch	85-100
No. 4	45-95
No. 200	0-8

The plasticity Index shall be no greater than 3 when tested in accordance with ASTM D 4318. The coarse aggregate shall have a percent wear of 50 or less than tested in accordance with ASTM C.

2.02 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial mixture or field experience methods as specified in ACI 301, Section 3. If trial mixture

method is used, employ an independent testing facility, acceptable to Architect, for preparing and reporting proposed mix designs.

- B. Submit written reports to Architect, or Engineer, of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been approved.

C. Concrete Strengths.

1. Structural Elements: 3000 psi
2. Site Paving: 4000 psi

D. Admixtures

1. Use air-entraining admixture in all concrete, except air entrainment may be omitted from concrete to receive a steel trowel finish. The entrained air content for exterior concrete shall be 4-7 percent.
2. Use water reducing admixture conforming to ASTM C 494, Type A, in all concrete unless approved otherwise by the Structural Engineer.
3. Use high range water reducing admixture conforming to ASTM C 494, Type F, in all concrete slabs unless approved otherwise by the Structural Engineer.
4. All other admixtures shall have the written approval of the Architect or Structural Engineer.
5. Calcium chloride is not permitted.
6. All admixtures, except high range water reducers, shall be added to the concrete at the batch plant.
7. Concrete for slabs to receive a steel trowel or float finish shall not contain both fly ash and high range water reducer.

PART 3 – EXECUTION

3.01 COORDINATION

- A. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel. Set screeds accurately. Embedded items shall be accurately aligned and adequately supported. Verify installation of mechanical, plumbing, and electrical items to be embedded in concrete. Correct any unsatisfactory condition before proceeding further.

3.02 PREPARATION

- A. Before placing concrete, clean and roughen surface of previously placed concrete. Clean reinforcing steel. Remove debris, providing clean-outs at bottom of forms when necessary. Moisten surfaces to receive concrete unless otherwise prepared. Remove excess water before placing concrete.

3.03 CONCRETE PLACEMENT

- A. General: Comply with ACI 301.
- B. Place concrete continuously in layers not deeper than 24 inches. Concrete shall not be placed against concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable to its final location to avoid segregation. Do not use vibrators to transport concrete.
- C. Maintain reinforcing in proper position during concrete placement operations.
- D. Consolidate concrete, immediately after placing, by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.
- E. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface. Do not disturb slab surfaces prior to beginning finishing operations.
- F. Cold Weather Concreting: Protect concrete work from physical damage or reduced strength caused by frost, freezing or low temperatures. Comply with ACI 306.1.
- G. Hot Weather Concreting: When hot weather conditions exist that would impair quality and strength of concrete, reduce delivery time of ready mix concrete, lower the temperature of materials, or add retarder to ensure that the concrete is plastic. Retempering with water is not allowed.

3.04 FINISH OF FORMED SURFACES

- A. Rough Form Finish: Provide where formed concrete surfaces are not exposed to view. Tie holes and surface imperfections shall be repaired and patched and fins and other projections exceeding ¼" in height rubbed down or chipped off.

3.05 FINISH OF HORIZONTAL SURFACES

- A. At tops of foundation walls and grade beams finish with a texture matching adjacent formed surfaces unless otherwise indicated.

3.06 SLAB FINISHES

- A. Float Finish: Begin floating when surface water has disappeared and when concrete has stiffened sufficiently to permit operation of power-driven or hand floats. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface planes to a tolerance not exceeding ¼ inch in 10 feet when tested with a 10 foot straight edge.
- B. Scratch Finish: Apply scratch finish to slab surfaces that are to receive floor topping. Roughen surface before final set, using stiff brushes, or brooms.

- C. Trowel Finish: Apply trowel finish to all slab surfaces unless noted otherwise. After floating, begin first trowel finish using a power-driven or hand trowel. Finish concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8 inch in 10 feet when tested with a 10 foot straight edge.
- D. Broom Finish: Apply on exterior slabs, ramps, steps, and sidewalks. Immediately after concrete has received a float finish, draw a broom or burlap belt across the surface to give a course transverse scored texture.

3.07 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Continue curing for at least 7 days.
- B. Moisture-retaining cover curing: All interior concrete slabs are to be cured with a moisture retaining cover for the first 7 days. After that time, the cover shall be removed and the slab should be allowed to dry. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3” and sealed. Repair any holes or tears in cover during curing period.
- C. Curing compound: At contractor’s option, exterior concrete slabs may be cured using curing compound. All vertical concrete (walls, beams, etc...) shall be cured using curing compound – apply compound to the vertical surface as soon as the forms are removed. Apply curing compound uniformly in accordance with the manufacturer’s printed instructions. Curing compound shall NOT be used on interior slabs.

3.08 CONCRETE SURFACE REPAIRS

- A. Patching Surface Imperfections: Remove loose material and patch surface imperfections and holes left by tie rods with cement mortar. Surface imperfections include honeycomb, excessive air voids, sand streaking and cracks.

3.09 FOR EXPOSED-TO-VIEW SURFACES

- A. Blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

3.10 FIELD QUALITY CONTROL

- A. The Contractor shall employ the services of a qualified testing laboratory to perform tests and submit test reports.
- B. Sampling Fresh Concrete: ASTM C 172.
- C. Slump: ASTM C 143; one test for each set of compressive strength test specimens.

- D. Air Content: ASTM C 173 or C 231 for each set of compressive strength test specimens.
- E. Concrete Temperature: Test hourly when air temperature is 40 degrees F. and below, when 80 degrees F and above; and when compression test specimens are made.

- F. Compression Test Specimen: ASTM C 31, one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field cure test specimens are required. Mold one set of standard cylinders for volume of concrete specified below or fraction thereof.
 - 1. Slabs on Grade 25 cubic yards
 - 2. Footings and stem walls 8 cubic yards
 - 3. All other locations (unless noted otherwise) 25 cubic yards

- G. Compressive Strength Tests: ASTM C 39; test 1 specimen at 7 days, 2 specimens at 28 days, and retain one specimen in reserve for later testing. Additional Tests: The testing laboratory will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure as directed by the Architect. The testing laboratory may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by the Architect or Engineer. The Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END OF SECTION

SECTION 03 45 00 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to the work specified in this section.
- 1.2 DESCRIPTION OF WORK
- A. Extent of architectural precast concrete (ArPC-Conc) work is shown on drawings and in schedules.
- B. Architectural precast concrete includes the following:
1. Plain smooth-faced concrete units (including special formed units) to match existing.
 2. Ties, leveling plates shims, bearing pads, clip angles, support angles, and other accessories required to erect, support, anchor, or interconnect precast units.
- C. Caulking, sealants, and gaskets are specified in Division 7.
- 1.3 QUALITY ASSURANCE
- A. Precast Concrete Units:
1. ACI 318 "Building Code Requirements for Reinforced Concrete".
 2. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
 3. Comply with recommended practices and procedures of Pre-stressed Concrete Institute (PCI) MNL-117, "Manual for Quality Control for Plants & Production of Architectural Precast Concrete Products", for production and quality control of architectural precast units PCI MNL-122 "Architectural Precast Concrete" and as herein specified.
- B. Fabricator Qualifications: Firms which have a minimum of 5 years successful experience in the fabrication of architectural precast concrete units, similar to units required for this project, will be acceptable. Fabricator must have sufficient production capacity to produce, transport, and deliver required units without causing delay in the work.
- C. Fabrication Qualifications: Produce precast concrete units at fabricating plant engaged primarily in manufacturing of similar units, unless plant fabrication or delivery to site is impractical.
1. If units are produced at locations other than precast concrete fabricating plants, maintain procedures and conditions for quality control equivalent to plant productions.
- D. Design modifications may be made only as necessary to meet field conditions and to ensure proper fitting of the work, and only as acceptable to Architect. Maintain general design concept shown without increasing or decreasing sizes of members or altering profiles and alignment shown. Provide complete design calculations and drawings prepared by a registered professional engineer, if requested by Architect, if design modifications are anticipated.
- E. Qualifications of Erector: Firms which have a minimum of 2 years successful experience in the erection of architectural precast concrete units, similar to units required for this project, will be acceptable.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications, data and instructions for manufactured materials and products. Include mix designs, manufacturer's certifications, and laboratory test reports as required.
1. Include water absorption test reports for units with exterior exposure.
- B. Shop Drawings: Submit drawings showing complete information for fabrication and installation of precast concrete units. Indicate member dimensions and cross section; location, size and type of reinforcement, including special reinforcement and lifting devices necessary for handling and erection.
1. Include erection procedure for precast units, sequence of erection, and required handling equipment.
 2. Show layout, dimensions, & identification of each precast unit corresponding to sequence & procedure of installation. Indicate welded connections by AWS standard symbols. Detail inserts, connections, & joints, including accessories & construction at openings in precast units.
 3. Show location and details of anchorage devices that are to be embedded in other construction. Shop drawings to show surrounding construction as shown in the construction documents.
 4. Show all joints, including expansion joints ('soft' type) and grouted joints ('rigid' type).
 5. Indicate protective finishes for metal items including connectors.
- C. Provide completed design calculations for all precast and precast attachment/support structures by a registered engineer licensed in the State of New Mexico complete with stamp and signature on submitted documents.
- D. Samples:
1. For initial selection purposes: Submit precast samples to illustrate quality, color, and texture of surface finishes available.
 2. For Verification Purposes: Submit 2 (two) samples approximately 12" X 12" X 2" to illustrate quality, color, and texture of surface finishes. Approved samples shall be retained at the site and manufacturer's place of fabricator for use as a "control sample".
 3. Submit samples of cast-in gaskets, anchorages, and other attachment and accessories as requested by Architect.
 4. Prepare full size samples of each typical type architectural precast concrete unit for Architect's inspection at production plant or on site prior to start of installation work, and after Architects review of finished samples. Acceptable full size samples may be incorporated in job installation.
 5. Architect's review of samples will be for color, texture and general condition only. Compliance with other requirements is the exclusive responsibility of the Contractor.
- E. Provide Owner/Architect or Owner's representative free access to manufacturing site during fabrication.
- 1.5 DELIVER, STORAGE AND HANDLING: Deliver precast concrete units to project site in such quantities and at such times to assure continuity of installation. Store units at project site to prevent cracking, distortion, warping, staining, or other physical damage and so that markings are

visible. Lift and support units only at designated lifting or supporting points as shown on final shop drawings.

PART - 2 PRODUCTS

2.1 FORMWORK

- A. Provide forms and, where required, form facing materials of metal, plastic, wood, or other acceptable material that is nonreactive with concrete and will produce required finish surfaces.
- B. Accurately construct forms, mortar tight, and of sufficient strength to withstand pressures due to concrete placing operations, temperature changes & when pre-stressed pre-tensioning & de-tensioning operations. Maintain frame work to provide completed precast concrete units, of shapes, lines and dimensions indicated, within specified fabrication tolerances.
 - 1. Unless forms for plant manufactured pre-stressed concrete units are stripped prior to de-tensioning, design forms so that stresses are not induced in precast units due to deformation of concrete under pre-stress or to movement during de-tensioning.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615 and as follows:
 - 1. Provide Grade 40 for bars No. 3 and No. 4 for stirrups and ties.
 - 2. Provide Grade 60 for bars No. 3 to 18, except as noted otherwise.
- B. Steel Wire: ASTM A 82, plain, cold-drawn, steel.
- C. Welded Wire Fabric: ASTM A 185.
- D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing.
 - 1. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are hot-dip galvanized, plastic protected or stainless steel protected.

2.3 PRE-STRESSING TENDONS

- A. Uncoated, 7-wire stress relieved strand complying with ASTM A 416. Use Grade 250 unless Grade 270 required or shown on drawings.
- B. Strand similar to above, but having size and ultimate strength of wires increased so that ultimate strength of the strand is increased approximately 15%, or strand with increased strength but with fewer number of wires per strand, may be used at manufacturer's option.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III.
 - 1. Use low alkali cement containing a maximum of .07 percent free alkalis.
- B. Use only one brand and type of cement throughout the project, unless otherwise acceptable to

Architect.

1. Use "white" or "buff" portland cement for concrete mix for initial selection of color sample submittal. Provide three different color samples for Architect's initial selection, one of which is seven parts "white" to one part "buff". The other color samples to be variations of "white" and "buff" blend.
 - C. Water: Potable or free from foreign materials in amounts harmful to concrete and embedded steel.
 - D. Air-Entraining Admixture: ASTM C 260.
 - E. Calcium Chloride: Do not use calcium chloride in precast pre-stressed concrete.
 - F. Aggregates: Course and fine ASTM C33; hard durable, carefully selected and graded; free of material causing staining or reacting with cement. Use aggregate from source as required to match control sample. Fine aggregate from same material as course, unless otherwise specified.
- 2.5 CONNECTION MATERIALS: Provide all necessary pins, dowels, bars, clips, angles or other structural shapes as required for attachment/support on the building structure for a complete installation or as shown on drawings. Provide under this section units for installation in Section 03 30 00.
- A. Steel Shapes and Plates: ASTM A 36.
 - B. Anchor Bolts: ASTM A 307, low-carbon steel bolts, regular hexagon nuts and carbon steel washers.
 - C. Finish of Steel Units: Exposed units galvanized per ASTM A 153; others painted with rust inhibitive primer.
- 2.6 GROUT MATERIALS
- A. Nonmetallic Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with Corps of Engineers CRD-C558, Type A. Color: As selected by Architect.
- 2.7 PROPORTIONING AND DESIGN OF MIXES
- A. Prepare design mixes for each type of concrete required.
 - B. Design mixes may be prepared by an independent testing facility or by qualified precast manufacturing plant personnel, at precast manufacturer's option.
 - C. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each type of concrete required, complying with ACI 318.
 - D. Concrete: Standard weight concrete with compressive strength of 5000 psi at 28 days and an air content not less than 4% nor more than 6%. Water absorption not to exceed 3 to 4 percent by weight; for improved weathering staining resistance.

- E. Submit written reports to Architect of proposed mix for each type of concrete at least 15 days prior to start of precast unit production. Do not begin concrete production until mixes and evaluations have been reviewed by Architect.
- F. Four compressive strength test cylinders shall be made for every 10 precast units, or fraction thereof, cast in any one day. Test 1 cylinder at 7 days, 2 cylinders at 28 days and retain one specimen for further testing as may be required.
- G. Adjustments to Concrete Mixes: Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by Architect before using in the work.
- H. Admixtures: Use air-entraining admixture in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low slump concrete, may be used subject to Architect's acceptance.
 - 1. Use amounts as recommended by admixture manufacturer for climatic conditions prevailing at time of placing. adjust quantities of admixtures as required to maintain quality control.

2.8 FABRICATION:

- A. General: Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances of PCI MNL-117, unless otherwise indicated.
- B. Fabricate units straight, smooth, and true to size and shape, with exposed edges and corners precise and square unless otherwise indicated.
 - 1. Precast units which are warped, cracked, broken, spalled, stained, not matching approved color samples or otherwise defective will not be acceptable.
- C. Built-In Items: Provide reglets, slots, holes, and other accessories in units to receive windows, cramps, dowels, flashings, and others similar work as indicated.
- D. Anchorages: Provide loose steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other miscellaneous steel shapes not provided by other trades, necessary for securing precast units to structural supports and adjacent members.
- E. Surface Finish: Fabricate precast units and provide exposed surface finishes as follows:
 - 1. Smooth surface finish free of pockets, sand streaks, and honeycomb "bug holes", with uniform color and texture to match Architect's control sample.
 - a. Surface finish to approximately cut limestone on the existing building.
 - 2. Textured surface finish imparted by form liners or inserts to provide surfaces free of pockets, and streaks and honeycomb, with uniform color and texture to match Architect's control sample. Provide acid washing and/or light sand blasting as required to match the Architect's sample (existing architectural concrete building soffits and eyebrows).
 - 3. As cast or float finish for unexposed surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Deliver anchorage items which are to be embedded in other construction before start of work. Provide setting diagrams, templates, instructions, and directions as required for installation.
- B. Do not install precast units until concrete has attained its design compressive strength.
- C. Install precast concrete members plumb, level, and in alignment with PCI MNL-117 specified limits of erection tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as members are being permanently connected.
 - 1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
- D. Accessories: Install clips, hangers, and other accessories required for erection of precast units to supporting members and backup materials.
- E. Anchor units in final position by bolting, welding, grouting, or as otherwise indicated. Remove temporary shims, wedges, and spacers as soon as possible after anchoring is completed.
 - 1. At bolted connections use lock washers or other acceptable means to prevent loosening of nuts.
 - 2. At welded connections apply rust inhibitive coating on damaged areas, same as shop applied material. Use galvanized repair coating on galvanized surfaces.
- F. Cleaning: Clean exposed facings to remove dirt and stains which may be on units after erection and completion of joint treatment. Wash and rinse in accordance with precast manufacturer's recommendations. Protect other work from damage due to cleaning operations. Do not use cleaning materials or processes which could change the character of exposed concrete finishes.

3.2 PERFORMANCE REQUIREMENTS:

- A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast units as required.
 - 1. Limitations as to the amount of patching which will be permitted is subject to acceptance of Architect.
- B. All precast concrete elements shall be handled at times by competent workmen and by such methods as will guard against soiling, mutilation, cracking, and chipping. All elements shall be set as shown on drawings and herein specified, level, plumb, and square with uniform joints true to line.
- C. The Erection Contractor shall examine all parts of the supporting structure and the conditions under which the precast concrete work is to be erected. He shall not proceed with the installation until the unsatisfactory conditions have been corrected in a manner acceptable to the Erection Contractor.
- D. The Erection Contractor shall verify dimensions of the supporting structures at the project site and adjust final shop drawings to reflect actual field dimensions.

- E. The Erection Contractor shall be responsible for any chipping, cracking, mishandling, or other damage to the precast elements after delivery to the site. Any damaged surfaces not repairable shall be replaced. In addition to above, in place precast units may be rejected for any one of the following:
1. Exceeding the specified installation tolerances.
 2. Damaged during construction operations.
 3. Exposed-to-view surfaces which develop surface finish deficiencies.
 4. Other defects as listed in PCI MNL-117.

3.3 ERECTION TOLERANCES

- A. Warpage: Fabricate and install wall panels so that each panel after erection complies with following dimensional requirements:
1. Bowing (concave or convex) of any part of a flat surface not to exceed length of bow/360, with a maximum of 3/4" up to 30 feet.
 2. Maximum warpage of one corner out of plane of other three, the greater of 1/16" per foot distance from nearest adjacent corner, or 1/8"
- B. Tolerances for Location of Precast Units: Fabricate and erect precast units so that joints between panels meet the following:
1. Face width of joints: Plus, or minus 3/16"
 2. Joint taper: 1/40" per foot length, with maximum length of tapering in one direction of 10 feet.
 3. Step in Face: 1/4".
 4. Jog in Alignment of Edge: 1/4".
 5. Alignment for exterior panels is outside face.
 6. Variations from Plumb: Plus, or minus 1/2" in any 40-foot run.
 7. Variation from Level: Plus, or minus 1/2" in any 40-foot run.

END OF SECTION 03 45 00

SECTION 04 01 05 – MASONRY REPAIRS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes; repointing existing mortar joints.

1. Refer to drawings for locations.

1.2 SUBMITTALS

A. Product Data:

1. Submit manufacturer's technical data for each product indicated, including recommendations for their application and use; include test reports and certifications substantiating that products comply with requirements

1.3 QUALITY ASSURANCE

A. Performance Requirements:

1. Perform Work in accordance with MSJC Code and MSJC Specification.

B. Qualifications:

1. Installer: Company specializing in performing Work of this Section with minimum five years documented experience.

C. Mockup:

1. Restore and repoint a masonry wall, at a location directed by the Architect, including mortar and accessories.
2. Acceptable mock up area illustrating results of restoration will become standard for Work of this Section.

D. Pre-Installation Conference:

1. Convene minimum one week prior to commencing Work of this Section.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store mortar ingredients in manufacturer's packaging, or when delivered loose, with adequate weatherproof covering.
- B. Comply with manufacturer's recommendations for minimum and maximum temperature requirements for storage.

1.5 PROJECT CONDITIONS

A. Environmental Requirements - Rebuilding Materials:

- 1. Hot and Cold Weather Requirements: MSJC Specification.

B. Environmental Requirements - Cleaning Operations:

- 1. Do not apply at surface and air temperatures below 40 degrees F or above 95 degrees F unless otherwise indicated by manufacturer's written instructions.
- 2. Do not apply when surface and air temperatures are not expected to remain above 40 degrees F for a minimum of eight hours after application, unless otherwise indicated by manufacturer's written instructions.
- 3. Do not apply to frozen substrate; allow adequate time for substrate to thaw, if freezing conditions exist before application.
- 5. Do not apply consolidation or protective treatments earlier than 24 hours after rain or if rain is predicted for a period of 6 hours after application, unless otherwise indicated by manufacturer's written instructions.

- C. Dispose of run-off from cleaning operations by legal means and in a manner which prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

1.6 SEQUENCING

- A. Provide masonry repair and any cleaning materials and other construction in ample time to complete Work in a timely manner.
- B. Perform repointing any before cleaning masonry surfaces.

PART 2 PRODUCTS

2.1 COMPONENTS - EXTERIOR REPAIRS AND (ANY) CLEANING

- A. Water for Cleaning: Clean, potable, free of oils, acids, alkalis, salts and organic matter.

B. Brushes: Fiber bristle only.

C. Mortar and Grout Materials: ASTM C270.

1. Mortar strength shall not exceed strength in existing masonry construction.
2. Tuck pointing mortar shall not be denser than original mortar; tuck pointing mortar shall be prehydrated.
3. Color match to existing mortar.

F. Brick:

1. Recovered cleaned brick from areas of selective demolition.

PART 3 EXECUTION

3.1 PREPARATION

A. Protect elements surrounding Work of this Section from damage or disfiguration.

B. Immediately remove stains, efflorescence, or other excess resulting from Work of this Section.

C. Protect roof membrane and flashings from damage; lay 1/2 inch plywood on roof surfaces over full extent of work area and traffic route.

D. Protection:

1. Close off, seal, mask and board up areas, landscaping, materials and surfaces not receiving Work of this Section to protect from damage.
2. Protect persons and motor vehicles surrounding building whose masonry surfaces are being restored and surrounding buildings from injury resulting from masonry restoration Work.
3. Protect glass, unpainted metal trim and polished stone from contact with acidic chemical cleaners by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape; apply masking agent to comply with manufacturer's recommendations; do not apply liquid masking agent to painted or porous surfaces.
4. Protect unpainted metal from contact with alkali chemical cleaners by covering them either with liquid strippable masking agent or polyethylene film and waterproof masking tape.

3.2 INSTALLATION

A. Repointing:

1. Cut out loose or disintegrated mortar in joints to depths equal to 2-1/2 times their width, but not less than minimum 1/2 inch depth or until sound mortar is reached.
2. Utilize power tools only after test cuts determine no damage to masonry units results.
3. Do not damage masonry units, spall edge of masonry unit or widen joints; replace any masonry units which become damaged at the Contractor's expense.
4. When cutting is complete, remove dust and loose material by brushing with air jet; brush, vacuum or flush joints to remove dirt and loose debris.
5. Premoisten joint and apply mortar specified in Section 04 20 00; joint surfaces shall be damp but free of standing water.
6. Apply first layer of pointing mortar to areas where existing mortar was removed to depths greater than surrounding areas; apply in layers not greater than 3/8 inch until a uniform depth is formed; compact each layer thoroughly and allow to become thumb-print-hard before applying next layer.
7. After joints have been filled to a uniform depth, place remaining pointing material in three layers with each of the first and second layers filling approximately 2/5 of joint depth and third layer the remaining 1/5; fully compact each layer and allow to become thumb-print-hard before applying next layer.
8. Where existing units have rounded edges, recess final layer slightly from face.
9. Take care not to spread mortar over edges onto exposed surfaces or to feather edge mortar.
10. When mortar is thumb-print-hard, tool joints to match original appearance of joints, unless otherwise indicated.
11. Tuck pointing mortar shall not be denser than original mortar.
12. Moist cure for 72 hours.
13. Where repointing Work precedes cleaning of existing masonry and stone, allow mortar to harden not less than 30 days before beginning cleaning Work.

3.4 FIELD QUALITY CONTROL

- A. As Work proceeds and on completion, remove excess mortar, smears, droppings, using stiff nylon bristle brushes and clean water, spray applied at low pressure (40 psi maximum); metal scrapers or brushes shall not be used; acid or alkali cleaning agents shall not be used.
- B. Remove temporary coverings and protection of adjacent work areas.
- C. Clean surrounding surfaces.
- D. Repair or replace damaged or deteriorated surfaces.
- E. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 04 01 05

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: Drawings & general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:

1. CMU – Acoustical / Structural 12” W x 16” L x 8” H for new Chiller Enclosure
2. CMU – Structural 12” W x 16” L x 8”H for new Chiller Enclosure
3. Face Brick – veneer for new Chiller Enclosure
4. Reinforcing steel per structural notes – see structural
5. Masonry joint reinforcement.
6. Masonry sealer for Face Brick anti-graffiti protection

B. Related Sections include the following:

1. Division 03 Section “Cast-in-Place Concrete.”
2. Division 03 Section “Pre-cast Concrete” coping for new Chiller Enclosure
3. Division 05 Section “Metal Fabrications” for new gate for new Chiller Enclosure
4. Division 07, Section “Joint Sealants” for sealing control and expansion joints in unit masonry.

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.

C. Mix Designs: For each of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.

1.6 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious material on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

- A. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that came in contact with such masonry.
 - 1. Protect sills, ledges, and projections from mortar droppings.
 - 2. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
- B. Hot-Weathered Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the complete Work or will impair the quality of completed masonry.

2.2 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide shapes indicated and as follows:
 - 1. Provide special shapes for lintels, corners (pistol cuts), jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners, unless otherwise indicated.
- B. Concrete Masonry Units: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
 - 2. Weight Classification: Medium weight, unless otherwise indicated.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 4. Color Exposed Faces: standard grey.

- C. Acoustical Concrete Masonry Units (ACMU):
1. Manufacturer: Sound Seal
 2. Soundblox – Type 12” RSC/RF4 – 4” sound absorbing chamber combined with a nominal 8” groutable area. Funnel shaped slots with metal foil septa and fibrous filler.
 3. Overall NRC: 0.80
 4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
 5. Weight Classification: Medium weight, unless otherwise indicated.
 6. Color Exposed Faces: mfg. standard.

2.2 FACE BRICK

- A. General: Provide shapes indicated and as follows:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

- B. Face Brick: ASTM C 216, Grade SW, Type FBS.

1. Unit compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi.
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated “not effloresced.”
4. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
5. Where shown to “match existing,” provide face brick matching color range, texture, and size of existing adjacent building brickwork.

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Types S.
- C. Aggregate for Mortar: ASTM C 144.
1. Mortar Aggregates: Standard grey and suitable for field painting.
- D. Water Potable.

2.4 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

1. Stirrups and ties, Grade 40.

B. Masonry Joint Reinforcement, General: ASTM A 951.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.5 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or urethane.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.6 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stain from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units begin cleaned.

1. Available Manufacturers:

- a. Diedrich Technologies, Inc.
- b. EaCo Chem, Inc.
- c. ProSoCo, Inc.
- d. Approved equals.

2.7 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

2. Limit cementitious materials in mortar to Portland cement and lime.

3. Limit cementitious materials in mortar for exterior and reinforced masonry to Portland cement and lime.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- D. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed- joint and head-joint thicknesses by more than 1/8 inch.
 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/6 inch except due to warpage of masonry units within tolerances specified for warpage of units.
 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets.

Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond to match existing; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow masonry as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 MASONRY JOINT REINFORCEMENT (CMU)

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.6 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.7 REINFORCED UNIT MASONRY INSTALLATION

- A. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602 Section 2104.5 in the Uniform Building Code.
- B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.8 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 04 20 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - a. Steel angle frames for support of shaft wall and new duct penetrations and indicated accessories/fasteners.
 - 3. Steel gates and gate supports and accessories for the new Chiller Enclosure as indicated on the drawings.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- C. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, wedge-type inserts, embed plates and other items indicated to be cast into concrete.
 - 2. Division 04 Section "Unit Masonry" for new Chiller Enclosure.
 - 3. Division 05 Section "Structural Steel Framing."
 - 4. Division 09 Section "Paint"

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Premanufactured items.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications..

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code - - Steel."
 2. AWS D1.3, "Structural Welding Code - - Sheet Steel."
 3. AWS D1.6, "Structural Welding Code - - Stainless Steel."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 2. Provide allowance for trimming and fitting at site.

1.7 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordinate installation of steel weld plates and angels for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufactures: Subject to compliance with requirements, provide products by one of the manufactures specified or prior approved equals.
- B. Manufactured Products:
1. Stair Nosings for cast in place concrete stairs – Wooster Products, Ferrogrit-tm Type 101, 3 inch x width of stair. Or approved equal.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.3 FERROUS METALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- F. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- G. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless another weight is indicated or required by structural loads.
- H. Slotted Channel Framing: Cold-formed metal box channels with continuous slot complying with MFMA-3.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm).
 - 2. Material: Galvanized steel complying with ASTM A 653/A 653M, commercial steel, Type B, with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.
 - 3. Material: Steel complying with ASTM A 1008/A 1008M, commercial steel, Type B minimum thickness; coated with rust-inhibitive, baked-on acrylic enamel.
- I. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

2.4 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.5 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).
- D. Anchor Bolts/Nelson Studs: ASTM F 1554, Grade 36.
 - 1. Hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.
- E. Eyebolts: ASTM A 489.
- F. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- G. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- H. Wood Screws: Flat head, ASME B18.6.1.
- I. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- J. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- K. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material for Anchors in Exterior Locations: Alloy Group 1 (A1) stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
 - 1. Use primer with a VOC content of 420 g/L (3.5lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
 - 1. Use primer with a VOC content of 420 g/L (3.5lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Available Products:
 - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM 18/19.
 - b. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.

- c. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.
- d. Approved equals.

- E. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

- G. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

- H. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.7 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

- D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.8 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 1. Fabricate units from slotted channel framing where indicated.
 2. Furnish inserts for units are installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer unless otherwise indicated.

2.9 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.10 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.11 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.12 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- C. Bright, polished..
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.13 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Wood grounds, nailers, and blocking.

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

1. Division 07 Section, "Sheet Metal Flashing and Trim".

C. DEFINITIONS: Rough carpentry includes carpentry work not specified as part of other Sections and generally not exposed, unless otherwise specified.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material:

2. For fire-retardant-treated wood products include certification by treating plant that treated material complies with specified standard and other requirements.

B. Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.

1. Warranty of chemical treatment manufacturer for each type of treatment.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Lumber Standards: Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" & with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

1. 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.

- B. 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 lumber with 15 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
 - 1. Moisture content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- C. Grade: "Standard" grade light-framing-size lumber of any species or board-size lumber as required. "No. 2 Common" or "Standard" grade boards per WCLIB or WWPA rules or "No. 2 Boards" per SPIB rules.

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.
 - 1. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power Driven Fasteners: National Evaluation Report NER-272.
 - 1. Wood Screws: ANSI B18.6.1.
 - 2. Lag Bolts: ANSI B18.2.1.
- D. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

2.4 FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS

- A. General: Where fire-retardant-treated wood is indicated, pressure impregnate lumber and plywood with fire-retardant chemicals to comply with AWPA C20 and C27, respectively, for treatment type indicated; identify "fire-retardant- treated wood" with appropriate classification marking of Underwriters Laboratories, Inc., U.S. Testing, Timber Products Inspection, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Current Evaluation/Research Reports: Provide fire-retardant-treated wood for which a current model code evaluation/research report exists that is acceptable to authorities having jurisdiction and that evidences compliance of fire-retardant-treated wood for application indicated.
- C. Interior Type A: For interior locations use fire-retardant chemical formulation that produces treated lumber & plywood w/the following properties under conditions present after installation.
- D. No reduction takes place in bending strength, stiffness, and fastener holding capacities below values published by manufacturer of chemical formulation that are based on tests by a qualified

independent testing laboratory of treated wood products identical to those indicated for this Project under elevated temperature and humidity conditions simulating installed conditions.

1. No other form of degradation occurs due to acid hydrolysis or other causes related to manufacture and treatment.
2. No corrosion of metal fasteners results from their contact with treated wood.
3. Exterior Type: Use for exterior locations & where indicated.

E. Inspect ea piece of treated lumber or plywood after drying & discard damaged or defective pieces

2.5 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWWA C2 (lumber) and AWWA C9 (Plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
 1. Do not use chemicals containing chromium or arsenic.
 2. or exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- B. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. After treatment, kiln dry lumber and plywood to a maximum moisture content of 19 and 15%, respectively. Treat indicated items and the following:
 1. Wood nailers, curbs, equipment, support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
- C. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft.
- D. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWWA M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.6 ENGINEERED WOOD PRODUCTS

A. Laminated-Veneer Lumber: A composite of wood veneers with grain primarily parallel to member lengths, manufactured with an exterior-type adhesive complying with ASTM D 2559. Product has the following allowable design values as determined according to ASTM D 5456:

1. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal- depth members.
2. Modulus of Elasticity, Edgewise: 1,800,000 psi.

PART 3 - PART - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
- B. Set rough carpentry to required levels & lines, with members plumb & true to line & cut & fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as required.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
 - 1. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- B. 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 involved. Remove temporary grounds when no longer required.

END OF SECTION 06 10 00

SECTION 06 20 00 - FINISH CARPENTRY

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 SUMMARY
- A. This Section includes the following:
 - 1. Interior Window Trim for Transparent finish (ADD ALT #1).
 - B. Related Sections include the following:
 - 1. Division 06 Section, "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
 - 2. Division 08 Section Wood Windows.
 - 3. Division 09 Section "Painting" for preparation of surfaces for transparent and painted finish.
- 1.3 DEFINITIONS: Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.
- 1.4 SUBMITTALS
- A. Product Data: For each type of product indicated, including finishing materials and processes.
 - B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - C. Samples for Verification: For the following:
 - 1. Lumber with or for transparent finish, 5 inches (125 mm) wide by 24 inches (600 mm) long, for each species and cut, finished on 1 side and 1 edge.
- 1.5 QUALITY ASSURANCE
- A. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- B. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units, within constraints of project schedule.
 - C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.
- 1.6 DELIVERY, STORAGE, AND HANDLING: Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.
- 1.7 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
 - B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- 1.8 COORDINATION: Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species for Opaque (Paint) Finish: Any closed-grain hardwood.

2.2 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.3 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide Custom grade interior woodwork complying with the referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/16 inch.
- D. Complete fabrication, including assembly, finishing, and decoration application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- E. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.4 SHOP FINISHING

- A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.
 - 1. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative overlay.
- D. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523:
 - 1. Grade: Custom.

2. AWI Finish System TR-2: Catalyzed lacquer.
3. Wash Coat for Stained Finish: Apply a vinyl wash coat to woodwork made from closed-grain wood before staining and finishing.
4. Sheen: Semigloss, 55-75 gloss units.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.
- B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- E. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 60 inches (1500 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
 2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.

- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 07 01 50.19 - PREPARATION FOR REROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Full tear-off of entire roof.
 - a. Except as noted on the drawings
2. Removal of base flashings.
3. Temporary roofing.

B. Related Requirements:

1. Section 00 20 00 "Information Available to all Proposers" for Hazardous Material Survey information regarding Asbestos Containing Materials (ACM) classifications.
2. Section 01 10 00 "Summary" for use of the premises and phasing requirements.
3. Section 01 50 00 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for reroofing preparation.
4. Section 07 54 23 "Thermoplastic Polyolefin (TPO) Roofing" for new roofing

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.
- B. Full Roof Tear-Off: Removal of existing roofing system from deck.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Temporary Roofing Submittal: Product data and description of temporary roofing system.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
 1. Include certificate that Installer is licensed to perform asbestos abatement.

- B. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.
- C. Landfill Records: Indicate receipt and acceptance of demolished roofing materials containing hazardous wastes, such as asbestos-containing materials, by a landfill facility licensed to accept them.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Trained or certified to perform asbestos abatement in the state or jurisdiction where Project is located.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning roofing removal. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Reroofing Conference: Conduct conference at Project site.
 - 1. Meet with Owner; Architect; testing and inspecting agency representative; roofing system manufacturer's representative; roofing Installer, including project manager, superintendent, and foreman; and installers whose work interfaces with or affects reroofing.
 - 2. Review methods and procedures related to roofing system tear-off and replacement, including, but not limited to, the following:
 - a. Reroofing preparation, including roofing system manufacturer's written instructions.
 - b. Temporary protection requirements for existing roofing system components that are to remain.
 - c. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.
 - d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
 - e. Existing roof deck conditions requiring notification of Architect.
 - f. Structural loading limitations of roof deck during reroofing.
 - g. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.
 - h. HVAC shutdown and sealing of air intakes.
 - i. Asbestos removal and discovery of asbestos-containing materials.
 - j. Governing regulations and requirements for insurance and certificates if applicable.
 - k. Existing conditions that may require notification of Architect before proceeding.

1.7 FIELD CONDITIONS

- A. Existing Roofing System: Membrane roofing over a built-up asphalt roof with tar and roofing felts that contain asbestos. The existing wall flashings and ductwork also contain residual

asbestos containing materials. – See Section 00 20 00 Information Available to All Proposers for the Hazardous Materials Survey.

- B. Owner will occupy portions of building immediately below reroofing area. Conduct reroofing so Owner's operations are not disrupted. Provide Owner with not less than 72 hours' notice of activities that may affect Owner's operations.
 - 1. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below affected area. Verify that occupants below work area have been evacuated before proceeding with work over impaired deck area.
- C. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- D. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- E. Conditions existing at time of inspection for bidding are maintained by Owner as far as practical.
 - 1. The results of an analysis of test cores from existing roofing system are available for Contractor's reference.
- F. Limit construction loads on roof to for roofing equipment and materials to 20 PSF for uniformly distributed loads. Do not concentrate loads distribute equipment and materials as the loading items to the roof proceeds.
- G. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.
 - 1. Remove only as much roofing in one day as can be made watertight in the same day.
- H. Hazardous Materials: A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Coordinate reroofing preparation with hazardous material remediation to prevent water from entering existing roofing system or building.

1.8 WARRANTY

- A. Existing Warranties: None.

PART 2 - PRODUCTS

2.1 TEMPORARY ROOFING MATERIALS

- A. Design and selection of materials for temporary roofing are Contractor's responsibilities.

2.2 AUXILIARY REROOFING MATERIALS

- A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of the new roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Shut off rooftop utilities and service piping before beginning the Work.
- B. Test existing roof drains to verify that they are not blocked or restricted. Immediately notify Architect of any blockages or restrictions.
- C. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.
- D. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- E. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
 - 1. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 ROOF TEAR-OFF

- A. General: Notify Owner each day of extent of roof tear-off proposed for that day [Retain first paragraph below for existing aggregate-ballasted elastomeric or thermoplastic roofing systems or for aggregate-surfaced foamed roofing. Retain option or revise to suit Project.
- B. Full Roof Tear-Off: Remove existing roofing and other roofing system components down to the deck.
 - 1. Remove wood blocking, curbs, and nailers unless otherwise indicated.
 - 2. Remove fasteners from deck **or cut fasteners** off slightly above deck surface.

3.3 DECK PREPARATION

- A. Inspect deck after tear-off of roofing system.

- B. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect. Do not proceed with installation until directed by Architect.
- C. Replace wood roof sheathing as directed by Architect. Roof sheathing replacement will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

3.4 TEMPORARY ROOFING

- A. Install approved temporary roofing over area to be reroofed where existing roofing has been removed.
- B. Remove temporary roofing before installing new roofing.

3.5 BASE/WALL FLASHING REMOVAL

- A. Existing Residual Tar of wall flashing has tested positive for asbestos and must be removed and disposed of similar to the existing roofing materials containing asbestos
- B. Remove existing base flashings. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.
- C. Remove existing parapet sheathing and replace with new parapet sheathing to comply with

3.6 DISPOSAL

- A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION 07 0150.19

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Sound attenuation insulation.
 - 2. Thermal insulation.
- B. Related Sections include the following:
 - 1. Division 09 Section "Gypsum Board" for installation in metal-framed assemblies of insulation specified by referencing this Section.
 - 2. Division 22 Section "Plumbing Insulation."
 - 3. Division 23 Section "HVAC Insulation."

1.3 DEFINITIONS

- A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.4 PERFORMANCE REQUIREMENTS

- A. Plenum Rating: Provide glass-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.
 - 1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500-fpm (13-m/s) air velocity.
 - 2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with Chaetomium globosium on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.
- C. Research/Evaluation Reports: For foam-plastic insulation.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having

jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

- A. Available Manufacturers:
 1. CertainTeed Corporation.
 2. Guardian Fiberglass, Inc.
 3. Johns Manville.
 4. Owens Corning.
 5. Approved equals.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
 1. For use as sound batt insulation at interior walls.
 2. Thickness and/or R-value as indicated on the drawings for existing exterior walls/roof.

2.2 AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

- A. Install units of cellular-glass insulation with closely fitting joints using method indicated:
 - 1. Coat edges of insulation units with full bed of adhesive to seal joints between insulation and between insulation and adjoining construction.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Set vapor-retarder-faced units with vapor retarder to warm-in-winter side of construction, unless otherwise indicated.
 - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- C. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

- 3.6 PROTECTION: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 54 23 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fully Adhered TPO membrane roofing system for roofing over new insulation with tapered crickets and cover board
2. Roof Insulation and tapered crickets..

B. Related Sections:

1. Division 06 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Division 07 Section "Preparation for Reroofing: for removal of existing roofing material and preparations prior to new roofing installation.
3. Division 07 Section "Sheet Metal Roofing Specialties" for metal roof penetration flashings, flashings, and counter flashings.
4. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

- A. TPO: Thermoplastic polyolefin.
- B. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspection agency to resist uplift pressure calculated according to ASCE/SEI 7.
 1. Uplift: 1-90 rating.
 2. Hail Resistance: SH.
 3. Wind Speed: 90 MPH

- D. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products:
 - 1. Sheet roofing, of color specified.
 - 2. Cover Board.
- D. Qualification Data: For qualified Installer and manufacturer.
- E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- G. Field quality-control reports.
- H. Maintenance Data: For roofing system to include in maintenance manuals.
- I. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is FM Approvals approved for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including roof insulation, fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. 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.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, roofing accessories, and other components of membrane roofing system.
 2. Warranty Period: 20 years from date of Substantial Completion.
 3. Warranted Wind Speed: 90 MPH
- B. Special Project Warranty: Submit roofing Installer's warranty, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TPO MEMBRANE ROOFING

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible fabric backed TPO sheet.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 2. Carlisle SynTec Incorporated.
 3. Firestone Building Products.
 4. Johns Manville.
 5. Prior Approved equals
 6. Thickness: 60 mils, nominal.
 7. Exposed Face Color: White.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Contact Adhesive: 80 g/L.
 - c. Other Adhesives: 250 g/L.
 - d. Single-Ply Roof Membrane Sealants: 450 g/L.
- B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard, water based.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.

- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.3 ROOF INSULATION

- A. General: Polyisocyanurate thermal insulation in thicknesses shown by the membrane manufacturer or a manufacturer acceptable to the membrane manufacturer for the required system warranty
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class I, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Available Manufacturers:
 - a. Apache Products Company.
 - b. Atlas Roofing Corporation.
 - c. Carlisle SynTec Incorporated –basis of design
 - d. Celotex Corporation.
 - e. Firestone Building Products Company.
 - f. GAF Materials Corporation.
 - g. Johns Manville International, Inc.
 - h. RMAX.
 - i. Approved equals

- 2.4 Cover Board: High Density Polyisocyanurate board ASTM D1621, with premium coated glass facers and suitable for use in a fully adhered systems. Must be approved by membrane manufacturer for incorporation into the warranted Roof System.
 - 1. Carlisle Syn-tec SecurShield HD Plus – basis of design
 - 2. Approved equals

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.

2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 INSULATION INSTALLATION

- A. Comply with membrane roofing system requirements for indicated insulation system and insulation manufacturer's written instructions for installing roof membrane to insulation system.
 1. Install in a minimum of two layers with all joints staggered.

3.4 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.
- B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- F. Apply membrane roofing with side laps shingled with slope of substrate where possible.
- G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.

2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- B. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

3.7 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 54 23

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes sheet metal flashing and trim in the following categories:

1. Metal flashings and counter flashings.
2. Brake Metal Shapes with Kynar Finishes
3. Miscellaneous sheet metal accessories.
4. Premanufactured penetration flashings.
5. Brake metal fabrications for ceiling closures at new acoustical ceilings in the corridors and classroom/offices where indicated

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

1. Division 07: "Thermoplastic Polyolefin (TPO) Roofing"
2. Division 07: "Joint Sealants".
3. Division 09: "Acoustical Ceilings"
4. Division 09: "Painting".

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

B. Fabricate and install flashings at roof edges to comply with recommendations of FM Loss Prevention Data Sheet 1-49 for the project wind zone.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

C. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details. Provide layouts at 1/8" scale and details at 3" scale.

D. Samples of sheet metal flashing, trim, and accessory items, in the specified finish.

1. 12-inch-long Samples of factory-fabricated products exposed as finished Work. Provide complete with specified factory finish.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, & extent to that indicated for this Project and with a record of successful in-service performance.

1.6 PROJECT CONDITIONS: Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 METALS

- A. Galvanized Steel Sheet: ASTM A 526, G 90 (ASTM A 526M, Z 275), commercial quality, or ASTM A 527, G 90 (ASTM A 527M, Z 275), lock-forming quality, hot-dip galvanized steel sheet with 0.20 percent copper, mill phosphatized where indicated for painting; not less than 0.0396 inch (20 ga.) thick, unless otherwise indicated.
 - 1. Flashing at exposed locations provide with Paint-Lok paint finish suitable for field finish painting.
 - 2. Brake Metal Shapes provide with Kynar Finish. Una Clad by Firestone or equal. Colors selected from full range of colors, standard and premium colors.

2.2 REGLETS AND COUNTERFLASHING SYSTEMS

- A. General: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces & compatible with flashing indicated.
- B. Surface-Mounted Type (For existing parapets): Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers and with channel for sealant at top edge.
 - 1) Stucco Type (For new stucco/EIFS parapets): Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
- C. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of the counterflashing lower edge.
 - 1. Material: Galvanized steel, 0.0217 inch thick.
- E. Manufacturers: Subject to compliance with requirements, provide by one of the following:
 - 1. Fry Reglet Corporation
 - 2. Hickman: W.P. Hickman Co.
 - 3. IMETCO: Albuquerque, NM (505)247-2278.
 - 4. Approved equals.

2.3 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Solder: ASTM B 32, Grade Sn50, used with rosin flux.
- B. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.
- C. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 07 Section "Joint Sealants."
- D. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.
- D. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.
- E. Asphalt Mastic: SSPC-Paint 12, Solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4 mm) dry film thickness per coat.
- F. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- G. Structural Pipe Supports, Mechanical Piping and Electrical Roof Penetration Flashing: Premanufactured for indicated roof membrane.

1. Provide Firestone Quickseam Pipe Flashing system or equal.

2.4 FABRICATION, GENERAL

- A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.
- B. Comply with details shown to fabricate sheet metal flashing & trim that fit substrates & result in waterproof & weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal. Provide expansion for running work, sufficient to permanently prevent leakage, damage or deterioration of work.
- C. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
- D. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder. Fabricate nonmoving seam in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- E. Expansion Provisions: Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- H. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
- G. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.
- H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.
 1. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.
- I. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.5 SHEET METAL FABRICATIONS

- A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.
- B. Base Flashing: Fabricate from the following material:
 1. Galvanized Steel: 0.0396 inch (20 gauge) thick at membrane roofing.
- C. Counterflashing: Fabricate from the following material:
 1. Galvanized Steel: 0.0276 inch (24 gauge) thick at membrane roofing.
 2. Stainless Steel: Where indicated – 24 gauge minimum
- D. Flashing Receivers: Fabricate from the following material:
 1. Galvanized Steel: 0.0276 inch (24 gauge) thick at membrane roofing.
- E. Equipment Support Flashing: Fabricate from the following material:

1. Galvanized Steel: 0.0276 inch (24 gauge) thick at membrane roofing.
- F. Roof-Penetration Flashing: Fabricate from the following material:
 1. Galvanized Steel: 0.0276 inch (24 gauge) thick at membrane roofing.
- G. Acoustical Ceiling Closures: Fabricate from 26 ga. Prepainted sheet metal – white.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Downspouts: Fabricate round downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
 1. Fabricated Hanger Style: Fig 1-35C according to SMACNA's "Architectural Sheet Metal Manual."
 2. Hanger Style: As shown on Drawings.
 3. Fabricate from the following materials:
 - a. Galvanized Steel: 0.0313 inch (22 gauge) thick.
- B. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from the following materials:
 1. Galvanized Steel: 0.028 inch (0.71 mm) thick.
- C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
 1. Galvanized Steel: 0.0313 inch (22 gauge) thick.
- D. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight.
 1. Coping Profile: Fig 3-4C according to SMACNA's "Architectural Sheet Metal Manual."
 2. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, exposed cover plate.
 3. Fabricate from the Following Materials:
 - a. Galvanized Steel: 0.013 inch (22 gauge) thick.

PART 3 - EXECUTION

- 3.1 EXAMINATION: Examine substrates and conditions under which sheet metal flashing & trim are to be installed & verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.
- 3.2 INSTALLATION
 - A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal 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.
- B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - C. Roof-Edge Flashings: Secure metal flashings at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.
 - D. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
 - E. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except where pre-tinned surface would show in finished Work.
 - 1. Do not solder the following metals: Coil-coated galvanized steel sheet.
 - 2. Pre-tinning is not required for the following metals: Lead.
 - 3. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 - F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
 - 1. Use joint adhesive for nonmoving joints specified not to be soldered.
 - G. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder. Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams with epoxy seams sealer. Rivet joints for additional strength.
 - H. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
 - 1. Bed flanges of work in a thick coat of roofing cement where required for waterproof performance.
 - I. Install reglets to receive counterflashing in manner & by methods indicated. Install counterflashing in reglets, either by snap-in seal arrangement or by wedging in place for anchorage & filling reglet with mastic or elastomeric sealant as indicated and depending on degree of sealant exposure.
 - J. Counterflashings: Coordinate installation of counter-flashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 inches and bed with sealant.
 - K. Roof-Drainage System: Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the item manufacturer, to drain roof in the most efficient manner. Coordinate roof-drain flashing installation with roof-drainage system installation.
 - L. Coping Installation: Install cleats, anchor plates, and other anchoring and attachment accessories

and devices with concealed fasteners. Anchor copings to resist uplift and outward forces according to performance requirements. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturers recommended spacing.

- M. Equipment Support Flashing: Coordinate equipment support flashing installation with roofing & equipment installation. Weld or seal flashing to equipment support member.
- N. Roof-Penetration Flashing: Coordinate roof-penetration flashing installation with roofing and installation of items penetrating roof. Install flashing as follows:
 - 1. Flash vent piping, use roof manufacturer's recommended flashing detail being careful not to block vent piping with flashing.
 - 2. Seal and clamp flashing to pipes and conduits penetrating roof, other than vent piping.
 - a. Other than vent pipes provide Portal Plus –Alumi –Flash boots with clamps.

3.3 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

- 3.4 PAINTING: Paint flashings without custom Kynar finish as directed and with color selected by Architect complying with Division 09 requirements as specified in Division 09 Section, "Painting".

END OF SECTION 07 62 00

SECTION 07 84 46 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- Joins in or between fire-resistance-rated constructions as indicated on the drawings.

- B. Related Sections:

- 1. Division 09 Section "Gypsum Board Shaft Wall Assemblies"
 - 2. Division 09 Section "Non Structural Metal Framing".
 - 3. Division 09 Section "Gypsum Board".
 - 4. Division 23 Fire Smoke Dampers

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For qualified Installer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
 - 1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:

- a. Fire-resistive joint system products bear classification marking of qualified testing agency.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
 1. Joints include those installed in or between fire-resistance-rated walls and floor or floor/ceiling assemblies.
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Grace Construction Products.
 - b. Hilti, Inc.
 - c. Johns Manville.
 - d. 3M Fire Protection Products.
 - e. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - f. USG Corporation.
 - g. Approved equals.
- C. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

- D. SAFING INSULATION
 - 1. Slag-wool-fiber or rock-wool-fiber insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 07 84 46

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Acoustical joint sealants.

B. Related Sections:

1. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
2. Division 08 Section "Wood Windows"
3. Division 09 Section "Gypsum Board" for sealing perimeter joints.
4. Division 09 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. 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.
- C. 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.
- D. 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.

1.4 QUALITY ASSURANCE

- A. Installer 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. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.5 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.

1.6 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.

PART 2 - PRODUCTS

2.1 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.

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 - 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. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 890.
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.
 - f. Tremco Incorporated; Spectrem 1.
 - g. Prior approved equals.
- B. Multicomponent, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type M, Grade P, Class 100/50, for Use T.
 - 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. Dow Corning Corporation; FC Parking Structure Sealant.
 - b. May National Associates, Inc.; Bondaflex Sil 728 RCS.
 - c. Prior approved equals.
- C. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
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. Pecora Corporation; 898.
- D. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
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. BASF Building Systems; Omniplus.
 - b. Dow Corning Corporation; 786 Mildew Resistant.
 - c. GE Advanced Materials - Silicones; Sanitary SCS1700.
 - d. May National Associates, Inc.; Bondaflex Sil 100 WF.
 - e. Tremco Incorporated; Tremsil 200 Sanitary.

2.3 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
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. Pecora Corporation; AC-20 FTR.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - c. Prior approved equals.

2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

- A. 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 to joint substrates.
- B. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 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.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Glazed surfaces of ceramic tile.

- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at

perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between different materials listed above.
 - 2. Urethane Joint Sealant: Multicomponent, nonsag, traffic grade, Class 25.
 - 3. Joint-Sealant Color: Match Architect's sample] As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precast architectural concrete units.
 - c. Control and expansion joints in unit masonry.
 - d. Joints in exterior insulation and finish systems.
 - e. Joints between metal panels.
 - f. Joints between different materials listed above.
 - g. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - h. Control and expansion joints in ceilings and other overhead surfaces.
 - 2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - 2. Silicone Joint Sealant: Multicomponent, pourable, traffic grade, neutral curing.
 - 3. Joint-Sealant Color: Match Architect's sample.

- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces of interior unit masonry concrete walls and partitions.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
 2. Joint Sealant: Latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Location:
 - a. Acoustical joints where indicated.
 2. Joint Sealant: Acoustical.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - 1. Division 08 Section "Door Hardware" for door hardware for hollow-metal doors

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Ceco Door Products; an Assa Abloy Group company.
 2. Curries Company; an Assa Abloy Group company.
 3. Rocky Mountain Metals, Inc.
 4. Steelcraft; an Ingersoll-Rand company.
 5. Approved equals.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At interior locations.
 1. Physical Performance: Level B according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 3. Frames:

- a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
- b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

E. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

2.6 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

- C. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

- B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
 - 1. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 2. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
 - c. At Bottom of Door: 3/4 inch (19.1 mm) plus or minus 1/32 inch (0.8 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.

- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of access doors:
 - 1. Fire rated access door for installation in gypsum board assemblies.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 09 Section, "Gypsum Board Shaft Wall Assemblies".
 - 2. Division 09 Section, "Painting".
 - 3. Division 23 Section for concealed mechanical, plumbing, and fire protection equipment access.
 - 4. Division 26 Section for concealed electrical equipment access.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of Contract & Division 1 Specification Sections.
- B. Product data for each type of access door assembly specified, including details of construction relative to materials, individual components, profiles, finishes, and fire-protection ratings (if required).
 - 1. Include complete schedule, including types, general locations, sizes, wall and ceiling construction details, latching or locking provisions, and other data pertinent to installation.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain each type of access doors from one source and by a single manufacturer.
- B. Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies tested for fire-test-response characteristics per test method as indicated below, and are labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Test Method for Vertical Installations: ASTM E 152.
 - 2. Test Method for Horizontal Installations: ASTM E 119.
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.

1.5 COORDINATION: Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified under "Submittals" Article.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Cesco Products.
 - 2. J.L. Industries.
 - 3. Larsen's Manufacturing Co.
 - 4. Milcor, Inc.
 - 5. Approved equals.

2.2 MATERIALS

- A. Steel Sheet: ASTM A 366/A 366M commercial-quality, cold-rolled steel sheet with baked-on, rust-inhibitive primer. Provide at all gypsum board finished wall and ceiling locations.
- B. Stainless-Steel Sheet: ASTM A 167, Type 304 with No. 4 finish according to ASTM A 480/A 480M. Provide at all ceramic tile wall locations and as indicated on drawings.

2.3 ACCESS DOORS

- A. Noninsulated, Fire-Rated Doors for Walls and ceilings: Self-latching units consisting of frame, trim, door, and hardware, including automatic closer, interior latch release, and complying with the following requirements:
 - 1. Frame: 0.0598-inch- (1.52-mm-) thick steel sheet.
 - 2. Door: 0.0598-inch- (1.52-mm-) thick steel sheet.
 - 3. Hinge: Continuous type.
 - 4. Latches: Bolt type, operated by either a ring turn or flush key device (keyed alike). Provide ring turn type at non-public accessible doors.
 - 5. Fire-Protection Rating for Walls: As indicated on the drawings
 - 6. Size: As noted on Drawings.

2.4 FABRICATION

- A. General: Manufacture each access door assembly as an integral unit ready for installation.
- B. Steel Access Doors & Frames: Continuous welded construction. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 - 1. (Typical) Exposed Flange: Nominal 1 to 1-1/2 inches (25.4 to 38.1 mm) wide around perimeter of frame.
- C. Locking Devices: Furnish number required to hold door in flush, smooth plane when closed.
 - 1. For cylinder lock, furnish 2 keys per lock and key all locks alike.

PART 3 - EXECUTION

3.1 PREPARATION: Advise Installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices. Furnish inserts and anchoring devices for access doors that must be built into other construction. Coordinate delivery with other work to avoid delay.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions for installing access doors.
- B. Coordinate locations of each access door with applicable code requirements for size and clearance if not otherwise indicated. Install insulated doors in exterior walls and roof plenum ceilings as required.
- C. Install concealed-frame access doors flush with adjacent finish surfaces.

3.3 ADJUST AND CLEAN

- A. Adjust hardware and panels after installation for proper operation.
- B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 085200 - WOOD WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes aluminum-clad wood windows.
- B. Related Sections:
 - 1. Division 06 Section: "Finish Carpentry" for interior casing trim

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review, discuss, and coordinate the interrelationship of wood windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
 - 3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
 - 4. Review interior wood trim installation and coordination.
 - 5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for wood windows.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.

- D. Samples for Verification: For wood windows and components required, prepared on Samples of size indicated below:
 - 1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
 - 2. Exposed Hardware: Full-size units.
- E. Product Schedule: For wood windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of wood window, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating wood windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.
- B. Installer Qualifications: An installer acceptable to wood window manufacturer for installation of units required for this Project.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - b. Glazing Units: 10 years from date of Substantial Completion.
 - c. Aluminum-Cladding Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Andersen E Series Windows or comparable product by one of the following:
 - 1. Prior Approved Equals
- B. Source Limitations: Obtain wood windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Window Certification: WDMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 - 1. Minimum Performance Class: LC.
 - 2. Minimum Performance Grade: 25.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.36 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K).
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.24.

2.3 WOOD WINDOWS

- A. Operating Types: Provide the following operating types in locations indicated on Drawings:
 - 1. Single hung; E-series
 - 2. Fixed; E-series
- B. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.
 - 1. Exterior Finish: Aluminum-clad wood.
 - a. Aluminum Finish: Manufacturer's standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight and complying with AAMA 2605.
 - b. Color: To match existing - White
 - 2. Interior Finish: Manufacturer's standard opaque and clear coat finish.

- a. Color: White
 - C. Insulating-Glass Units:
 - 1. Glass: ASTM C 1036, Type 1, Class 1, q3.
 - a. Kind: Fully tempered.
 - 2. Filling: Fill space between glass lites with air.
 - 3. Low-E Coating: Andersen Window E-Series, Low E4
 - D. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
 - 1. Dual Glazing: With stainless steel spacer and breather tubes.
 - E. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
 - 1. Exposed Hardware Color and Finish: Antique Brass.
 - F. Hung Window Hardware:
 - 1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
 - 2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
 - G. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
 - H. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
- 2.4 ACCESSORIES
- A. Dividers: Provide divider grilles in designs indicated for each sash lite.
 - 1. Quantity and Type: Three per sash, two permanently located at exterior and interior lites and one (stainless steel) permanently located between insulating-glass lites.
 - 2. Material: Basis of Design Manufacturer's Full Divided Light system
 - 3. Pattern: As indicated on Drawings.
 - 4. Profile: Ovolo.
 - 5. Color: Custom exterior, selected Mfg.'s finish option interior

2.5 INSECT SCREENS

- A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. .
 - 1. Basis of Design manufacturer' E-series aluminum frame to match window color.
 - 2. Type and Location: Half, outside for single-hung sashes.

2.6 FABRICATION

- A. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows.
- B. Glaze wood windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.

- B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 08 52 00

SECTION 09 21 16 - GYPSUM BOARD SHAFT-WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Shaft enclosures.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 07 Section, "Penetration Firestopping".
 - 2. Division 09 Section, "Gypsum Board Assemblies"
 - 3. Division 23 Fire Smoke Dampers

1.3 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C11 and GA 505 for definitions of terms for gypsum board construction not otherwise defined in this Section or other referenced standards.

1.4 PERFORMANCE REQUIREMENTS

- A. Performance Requirements, General: Provide gypsum board shaft-wall assemblies that comply with the following requirements:
 - 1. They are composed of proprietary gypsum board panels and metal components designed for erection from outside the shafts.
 - 2. They comply with performance requirements specified as determined from testing manufacturers' standard assemblies representing those indicated for this Project.
- B. Fire Resistivity:
 - 1. Fabricate & install gypsum board shaft- wall assemblies to have a 1-hour fire-resistance Ratings.
- C. Structural Performance Characteristics:
 - 1. Lateral Design Load: 5 psf.
 - 2. Deflection Limit: 1/240 of partition height, except where otherwise indicated.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product data from manufacturers for each type of gypsum board shaft-wall assembly and solid-type separation wall assembly specified.
- C. Engineering data from gypsum board shaft-wall assembly manufacturer certifying and substantiating compliance of gypsum board shaft-wall assemblies with structural performance requirements.

1.6 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: Provide gypsum board shaft-wall assemblies that comply with the following requirements:

1. Fire-resistance-rated assemblies are indicated by GA File Numbers in GA-600 "Fire Resistance Design Manual," design designations listed in the UL "Fire Resistance Directory," or by Warnock Hersey or another qualified testing and inspecting agency.
 - B. Single-Source Responsibility: Obtain components for gypsum board shaft-wall assemblies from a single manufacturer for each type of assembly indicated.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials in original packages, containers, and 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products from the following manufacturers or approved equals:
 1. Georgia-Pacific Corp.
 2. United States Gypsum Co.
 3. Approved Equals.

2.3 ASSEMBLY MATERIALS

- A. General: Provide standard materials and components listed in manufacturer's published product literature for gypsum board shaft-wall assemblies of type and application indicated. Provide gypsum & other panels in maximum lengths available to eliminate or minimize end-to-end butt joints and in thicknesses required to produce assemblies complying with structural and other performance requirements.
- B. Steel Framing: ASTM C 645.
 1. Protective Coating: ASTM A 653, G40 (ASTM A 653M, Z90), hot-dip galvanized coating.
 2. Studs: Manufacturer's standard profile for fire-resistance-rated assembly indicated.
 - a. Shaft Wall; Manufacturers standard C-H studs.
 3. Track (Runner):
 - a. Shaft Wall; Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches (50.8 mm), in depth matching studs and in thickness indicated in the Gypsum Board Shaft-Wall Assembly Schedule.
 4. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches (76.2 mm), in depth matching studs, and not less than 0.0329 inch (0.84 mm) thick.
 5. Corner and End Members: Manufacturer's standard profile framing member for use at corners or where assembly terminates at other work, in depth matching studs and in manufacturer's standard thickness not less than the stud thickness indicated in the Gypsum Board Shaft-Wall Assembly Schedule.
- C. Gypsum Liner Panels: Manufacturer's Proprietary liner panels in 1-inch (25.4 mm) thickness

and with moisture-resistant paper faces.

- D. Gypsum Wallboard: ASTM C 36, core type as required by fire-resistant assembly indicated, and as follows:
 - 1. Edges: Tapered.
- E. Accessories: Corner beads, edge trim, and control joints of material and shapes specified in the Division 09 Section "Gypsum Board" that comply with gypsum board shaft-wall assembly manufacturers recommendation for application indicated.
- F. Gypsum Wallboard Joint Treatment Materials: Provide materials complying with ASTM C 475 and recommendations of gypsum board shaft-wall assembly manufacturer for the applications indicated, and as specified in Division 09 Section, "Gypsum Board."

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board shaft-wall construction that comply with requirements indicated and recommendations of gypsum board shaft-wall assembly manufacturer.

2.5 BASIC ASSEMBLY DESCRIPTION

- A. General: Characteristics of selected components are described below for purposes of indicating proprietary gypsum board shaft-wall assemblies that are manufacturer's standard. Provide complete shaft-wall assemblies that comply with requirements indicated in this Article and Part 1 "Assembly Performance Requirements" Article.
- B. Cavity Shaft-Wall Assemblies : Provide assemblies constructed of proprietary gypsum liner panels inserted between steel tracks at each end of studs; with specially shaped steel studs engaged in tracks and fitted between gypsum liner panels; and with gypsum board on finished side or sides applied to studs in the number of layers, thicknesses and arrangement indicated.
 - 1. Gypsum Liner Panel Thickness: Not less than 1 inch.
 - 2. Stud Shape:
 - a. Shaft Walls: C-H.
 - 3. Stud Thickness: 0.0329-inch minimum thickness of base metal or as required for span and loading indicated.
 - 4. Stud Depth: As standard with manufacturer for gypsum board shaft-wall assemblies or solid-type separation wall assemblies indicated.
 - 5. Room-Side Finish: 1 layer of 5/8-inch-thick, firecode "X" gypsum board.
 - 6. Shaft-Side Finish: 1 layer of gypsum board of thickness indicated below; provide only where finish is indicated on shaft side as well as room side, otherwise leave 1" liner exposed.
 - a. Thickness: 5/8 inch, firecode "X".

PART 3 - EXECUTION

3.1 EXAMINATION: Examine substrates to which gypsum board shaft-wall assemblies attach or abut with Installer present. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed-on fireproofing is applied (when applicable), attach offset anchor plates or

ceiling runners (tracks) to surfaces indicated to receive sprayed-on fireproofing. Where offset anchor plates are required, install continuous units formed from hot-dip galvanized sheet steel of thickness indicated. Fasten plates to building structure with fasteners spaced not more than 24 inches o.c. Secure ceiling runners to offset plates with screws spaced 24 inches o.c.

- B. After sprayed-on fireproofing has been applied (when applicable), remove only as much fireproofing as needed to complete installation of shaft-wall assemblies. Protect from damage any fireproofing that remains.

3.3 INSTALLATION:

- A. General: Install gypsum board shaft-wall assemblies or solid-type separation wall assemblies to comply with performance and other requirements indicated as well as with manufacturer's installation instructions and the following:
 - 1. ASTM C 754 for installing steel framing.
 - 2. Division 09 Section "Gypsum Board" for applying and finishing gypsum wallboard.
- B. Do not bridge building expansion joints with shaft-wall assemblies; frame both sides of joints with furring and other support as indicated.
- C. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.
 - 1. At elevator hoistway door frames, provide jamb struts on each side of door frame. Provide other shaft-wall framing at opening according to assembly manufacturer's written recommendation.
 - 2. Where handrails or other items are indicated for direct attachment to gypsum board shaft-wall assemblies, provide galvanized steel reinforcing strip with 0.0329-inch (0.84 mm) minimum thickness of base (uncoated) metal in size indicated, accurately positioned and secured behind at least 1 face-layer panel as indicated.
- D. At penetrations in shaft wall or solid-type separation wall, maintain fire-resistance rating of entire assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, floor indicators, and similar items.

3.4 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to Installer that ensures gypsum board shaft-wall assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 09 21 16

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:
 - 1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
- B. Related Sections include the following:
 - 1. Division 09 Section "Gypsum Board" for gypsum board applied to steel framing.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 - 2. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40, (hot-dip galvanized) minimum, or shall have a protective coating with an equivalent corrosion resistance.

2.2 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).
 - a. At door jambs and where indicated provide 0.0312 (0-79 mm).
 - b. Provide thickness/gauge as required for height/span according to Manufacturer's design tables for height/span indicated on drawings.
 - 2. Depth: As indicated on Drawings.
- B. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.

2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (50.8-mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm).
- D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 2. Depth: 7/8 inch (22.2 mm).

PART 3 - EXECUTION

3.1 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.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install studs so flanges within framing system point in same direction.
1. Space studs as follows:
 - a. Single-Layer Application: 16 inches (406 mm) o.c., unless otherwise indicated.
 - b. Multilayer Application: 16 inches (406 mm) o.c., unless otherwise indicated.

- c. Tile backing panels: 16 inches (406 mm) o.c., unless otherwise indicated.
- B. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs 20 GA. (0.0312 inch) at each jamb, unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
- C. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum board.
- B. Related Sections include the following:
 - 1. Division 09 Section "Non-Structural Metal Framing" for non-structural framing that support gypsum board.
 - 2. Division 09 painting Sections for primers applied to gypsum board surfaces.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For the following products:
 - 1. Textured Finishes: Fine to medium for each textured finish indicated and on same backing indicated for Work.

1.4 QUALITY ASSURANCE

- 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.

1.5 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. 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.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum Co.
 - b. G-P Gypsum.
 - c. National Gypsum Company.
 - d. USG Corporation.
 - e. Approved equals
- B. Type X:
 - 1. Thickness: 5/8 inch, 1/2 inch permitted for ceilings .
 - 2. Long Edges: Tapered.
 - 3. Moisture Resistant: Where indicated.

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.
 - f. .

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Exterior Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: 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 setting-type, sandable topping compound.
 - 5. Skim Coat (If applicable): For final coat of Level 5 finish, use setting-type, sandable topping compound.

- D. Joint Compound for Exterior Applications:
 - 1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
- E. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.5 AUXILIARY 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.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 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 manufacturer.
- D. Sound Attenuation Blankets: As specified in Division 07 Section "Thermal Insulation"
- E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
 - 1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

2.6 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
- B. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. G-P Gypsum; Georgia-Pacific Ceiling Textures/Vermiculite.
 - b. USG Corporation; SHEETROCK Wall and Ceiling Spray Texture (Aggregated).
 - c. Approved equals.
 - 2. Texture: Light spatter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels horizontally perpendicular to framing, unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum,

from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws. Fasten base layers with screws.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
 1. 30 foot maximum spacing.
 2. Locate at door jambs unless otherwise indicated. Provide a joint at each jamb.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 2. LC-Bead: Use at exposed panel edges.
 3. L-Bead: Use where indicated.
 4. U-Bead: Use at exposed panel edges.
 5. Curved-Edge Cornerbead: Use at curved openings.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile.
 3. Level 3: Where indicated on Drawings.
 4. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
 5. Level 5: At all Restroom drywall surfaces
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.6 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.

- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.7 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 09 29 00

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes:
 - B. Standard Acoustical Tile Ceilings and Suspension Systems
- 2. Applied Acoustical Materials

- C. Related Sections include the following:
 - 1. Division 07 Section "Joint Sealants"
 - 2. Division 07 Section "Sheet Metal Flashings and Trim" for brake metal closures of the ceiling system in the corridors and classroom/offices where indicated.
 - 3. Division 09 Section "Gypsum Board"
 - 4. Division 21 and 22 Mechanical Equipment
 - 5. Division 26, Electrical Equipment

1.3 SUBMITTALS

- A. Product Data: For each type of product specified.
 - 1. Manufacturer's product specification and installation instructions for each acoustical ceiling material required and for each suspension system.
 - 2. Include manufacturer's recommendations for cleaning and refinishing acoustical units, including precautions against materials and methods which may be detrimental to finishes and acoustical performances.
- B. Samples for Verification: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
 - C. 12-inch-square samples of each acoustical panel type, pattern, and color.
 - D. Set of 12-inch-long samples of exposed suspension system members, including moldings, for each color and system type required.

1.4 QUALITY ASSURANCE

- 1.5 Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project & with a record of successful in-service performance.
- 1.6 Source Limitations for Ceiling Units and Suspension Systems: Obtain each acoustical ceiling panel and suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- 1.8 Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

- A. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.9 PROJECT CONDITIONS

- 1.10 Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete and inspected, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

- 1.11 COORDINATION: Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.12 EXTRA MATERIALS

- 1.13 Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

- 1.14 Acoustical Ceiling Units: Full-size units equal to 2.0 percent of amount installed.

- 1.15 Suspension System Components: Quantity of each exposed component equal to 2.0 percent of amount installed.

- 3. Deliver extra materials to Owner's local storage facility at the time of "Substantial Completion" of the work.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- 2.2 Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated. Provide sizes shown by reflected ceiling plans or the Room Finish Schedule.

- A. Mineral Fiber Acoustical Panels:

- B. ACT-1: 24" X 24" Mesa by Armstrong or approved equal, 3/4" thick with square edge for standard grid. NRC .60; CAC 33; LR .85. Color: White. Provide High Recycled Content (HRC) with 15% minimum post-consumer content.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements. Coordinate with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, and partition system, if any.

- B. Structural Class: Heavy-duty system. Unless otherwise noted in Structural Notes, assume IBC Seismic Class D.

- C. Exposed Suspension System:

- 1. All exposed system parts shall be white.
 - 2. Manufacturer's standard exposed runners, cross-runners and accessories, types to be

Prelude XL High Recycled Content (HRC) by Armstrong or approved equal, 15/16" wide, with exposed cross-runners coped to lay flush with main runners.

- D. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated.
 - a. Postinstalled Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
 3. Restraint wire complying with ASCE 7-10, 13.5.6, 13.5.6.2, and 13.5.6.2.2 shall be provided.
 4. Support Post: Sized for heights of installation.
- F. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.4 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable nonstaining latex sealant complying with ASTM C 834 & the following requirements:
- B. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- C. Products: Subject to compliance with requirements, provide one of the following:
- D. Acoustical Sealant for Exposed and Concealed Joints:
 - E. PL Acoustical Sealant; Chemrex, Inc., Contech Brands.
 - F. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
 - G. SHEETROCK Acoustical Sealant; United States Gypsum Co.
 - H. See Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

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3.1 EXAMINATION

- 3.2 Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical ceiling ceilings.

3.3 Proceed with installation only after unsatisfactory conditions have been corrected.

- 3.4 PREPARATION: Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling (or as shown on Drawings. If layout shown cannot be achieved, consult with Architect prior to proceeding). Avoid (if possible) using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.5 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook." Comply with governing regulations, fire resistance rating requirements as indicated, and industry standards applicable to the work.

B. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.

2. U.B.C.'s "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings": U.B.C. Standard 25-2, 1997 Edition (especially for lateral bracing requirements).

- C. Suspend ceiling hangers from building's structural members and as follows:

D. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

E. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

F. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

G. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

H. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.

I. Do not attach hangers to steel deck tabs.

J. Do not attach hangers to steel roof deck. Attach hangers to structural members.

K. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches (200 mm) from ends of each member.

- L. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers,

without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

- M. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m). Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- N. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- O. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - 2. Install panels with pattern running in one direction.
 - 3. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 - 4. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 5. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended by acoustical panel manufacturer.
 - 6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.
 - 7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.6 FIELD QUALITY CONTROL: Level suspension system to tolerances of 1/8" in 12'-0".

3.7 CLEANING: Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 00

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment even those that have a factory-applied final finish.
 - a. Paint all exposed surfaces incorporated in or associated with the work of this project. It is the Architect's intent to have at the projects completion all items coordinated with the projects color scheme.
 - b. Typical color schemes will require a typical wall color and accent wall color(s). Soffits may also require a typical soffit color and accent soffit color(s).
- C. Do not paint items in concealed spaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Light fixtures, unless noted otherwise.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Furred areas.
 - b. Ceiling plenums.
 - c. Utility tunnels.
 - d. Pipe spaces.
 - e. Duct shafts.
 - 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 - 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections:

1. Division 05 Section "Metal Fabrications" for shop priming ferrous metal.
2. Division 07 Section "Sheetmetal Flashing and Trim" for painting of sheet metal closures of the Acoustical Ceiling edges where indicate.
3. Division 08 Section "Hollow Metal Doors and Frames" for factory priming steel doors and frames.
4. Division 09 Section "Gypsum Board" for surface preparation of gyp board.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 5 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 10 and 25 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 25 and 50 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 60 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Initial Selection: For each type of finish-coat material indicated.

1. After product selection, Architect will furnish color chips for surfaces to be coated.

C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on the actual substrate.

1. On actual wall surface and other interior and exterior building components, provide painted finishes complete with all preparation and components. For walls paint 100 sq ft of surface as directed until required, sheen, color and texture is obtained. Simulate finished lighting conditions for review. For other items paint sufficient areas as to represent completed work.
 - a. Final acceptance of colors will be from samples applied on job.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F (10 and 32 deg C).
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F (7 and 35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
 - 1. Quantity: Furnish Owner with extra paint materials in quantities indicated below:
 - a. One (1) gallon of each type, color, and sheen of paint used on the project in a labeled and unopened container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Benjamin Moore & Co. (Benjamin Moore).
 - 2. Sherwin Williams Paints (SW) with equal to or better than those scheduled.
 - 3. Approved equals

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Colors: As selected by Architect from manufacturer's full range.
- D. Chemical Components of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:
 - 1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
 - 2. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
 - 3. Anticorrosive Coatings: VOC content of not more than 250 g/L.
 - 4. Varnishes and Sanding Sealers: VOC content of not more than 350 g/L.
 - 5. Stains: VOC content of not more than 250 g/L.
 - 6. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 7. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1,2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.
 - o. Hexavalent chromium.
 - p. Isophorone.
 - q. Lead.
 - r. Mercury.
 - s. Methyl ethyl ketone.
 - t. Methyl isobutyl ketone.
 - u. Methylene chloride.
 - v. Naphthalene.
 - w. Toluene (methylbenzene).
 - x. 1,1,1-trichloroethane.
 - y. Vinyl chloride.

2.3 EXTERIOR PRIMERS

- A. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.
 - 1. Sherwin Williams Pro Industrial Pro-Cryl Universal Metal Primer, B66-310, <100g/L VOC: Applied at a dry film thickness of not less than 2.0 mils.
 - 2. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils.
 - 3. Approved equals

- B. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
 - 1. Sherwin Williams Pro-Cryl Universal Metal Primer, B66-310, <100 g/L VOC: Applied at a dry film thickness of not less than 2.0 mils.
 - 2. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
 - 3. Approved equals

2.4 INTERIOR PRIMERS

- A. Interior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.
 - 1. Sherwin Williams Loxon Concrete & Masonry Primer, A24W8300, <100 g/L VOC: Applied at a dry film thickness of not less than 3.0 mils.
 - 2. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
 - 3. Approved equals

- B. Interior Gypsum Board and New Gypsum Plaster Primer: Factory-formulated latex-based primer for interior application.
 - 1. Sherwin Williams ProMar 200 Zero VOC Primer, B28W2600, 0 g/L VOC: Applied at a dry film thickness of not less than 1.2 mils.
 - 2. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
 - 3. Approved equals

- C. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive metal primer.
 - 1. Sherwin Williams Pro Industrial Pro-Cryl Universal Metal Primer, B66-310, <100 g/L VOC: Applied at a dry film thickness of not less than 2.0 mils.
 - 2. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils.
 - 3. Approved equals

- D. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
 - 1. Sherwin Williams Pro Industrial Pro-Cryl Universal Metal Primer, B66-310, <100 g/L VOC: Applied at a dry film thickness of not less than 2.0 mils.
 - 2. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
 - 3. Approved equals

2.5 EXTERIOR FINISH COATS

- A. Exterior Semigloss Acrylic Enamel: Factory-formulated semigloss waterborne acrylic-latex enamel for exterior application.
1. Sherwin Williams A-100 Exterior Latex Satin, A82 series, <50 g/L VOC: Applied at a dry film thickness of not less than 1.2 mils.
 2. Benjamin Moore; Moorcraft Super Spec Latex House & Trim Paint No. 170: Applied at a dry film thickness of not less than 1.1 mils.
 3. Approved equals.

2.6 INTERIOR FINISH COATS

- A. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.
1. Sherwin Williams ProMar 200 Zero VOC Eg-Shel, B26-2600 series, 0/L VOC: Applied at a dry film thickness of not less than 1.5 mils.
 2. Benjamin Moore; Moorcraft Super Spec Latex Eggshell Enamel No. 274: Applied at a dry film thickness of not less than 1.3 mils.
 3. Approved equals.
- B. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.
1. Sherwin Williams ProMar 200 Zero VOC Semi-Gloss, B31-2600 series, 0/L VOC: Applied at a dry film thickness of not less than 1.5 mils.
 2. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel No. 276: Applied at a dry film thickness of not less than 1.2 mils.
 3. Approved equals.
- C. Interior Waterborne Epoxy Semi Water Borne Epoxy Semi-Gloss-2 Coats Gloss Finish (At scheduled interior walls and ceilings of toilet rooms and janitor closets)
1. Sherwin Williams Pro Industrial Pre-Catalyzed Water-Based Epoxy Semi-Gloss, K46 serie, <150 g/L VOC.
 2. Devoe Paints: Tru-Glaze WB-4406.
 3. Approved equals.
- F. Tinted Concrete Floor Paint (with Full Gloss Finish)
1. Sherwin Williams Armor-Seal 8100 with tint.
 2. Approved equals.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 1. Provide barrier coats over incompatible primers or remove and reprime.
 2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - c. If transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

- a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 10. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by

- manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
 - a. No spray painting will be permitted unless permission is obtained from the Architect and Owner following review of samples.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical items to be painted include, but are not limited to, the following:
1. Uninsulated metal piping.
 2. Uninsulated plastic piping.
 3. Pipe hangers and supports.
 4. Tanks.
 5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 6. Duct, equipment, and pipe insulation.
 7. Mechanical equipment (roof top units and items exposed to public view) with factory finishes and factory-primed finish for field painting.
- F. Electrical items to be painted include, but are not limited to, the following:
1. Switchgear.
 2. Panelboards.
 3. Electrical equipment with factory finishes and factory-primed finish for field painting.
 4. All exposed and visible electrical equipment, conduits, enclosures, and accessories.
- G. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

- I. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
 - 1. Provide satin finish for final coats unless otherwise noted.
- J. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
 - 1. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
 - 2. Testing agency will perform appropriate tests for the following characteristics as required by Owner:
 - a. Dry film thickness.
 - 3. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 EXTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer.
 - a. Primer: Exterior ferrous-metal primer.
 - b. Finish Coats: Exterior semigloss acrylic enamel.

- B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a galvanized metal primer.
 - a. Primer: Exterior galvanized metal primer.
 - b. Finish Coats: Exterior semigloss acrylic enamel.

3.8 INTERIOR PAINT SCHEDULE

- A. Concrete and Masonry (Other Than Concrete Unit Masonry): Provide the following paint systems over interior concrete and brick masonry substrates:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior concrete and masonry primer.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
 - 2. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- C. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior ferrous-metal primer.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- D. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior zinc-coated metal primer.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- E. All-Service Jacket over Insulation: Provide the following finish system on cotton or canvas insulation covering:
 - 1. Flat Acrylic Finish: Two finish coats. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coats: Interior flat latex-emulsion size.
- F. Gypsum Board (Wet Areas): Provide the following finish system over gypsum board surfaces.
 - 1. Two Finish Coats over a primer.
 - a. Primer: Interior gypsum board primer as recommended by finish coat manufacturer.
 - b. Waterbase Catalyzed Epoxy
- G. Concrete Floors: Provide the following finish system over concrete floor surfaces:
 - 1. High gloss at painted colored concrete floor – per manufactures requirements.
 - 2. Gloss 2 Part (2K) Waterbased Polyurethane Paint – two finish coats.

END OF SECTION 09 91 00

SECTION 22 00 00 - PLUMBING INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Plumbing Work, as indicated on the Drawings, and specified herein. Plumbing work indicated on the Drawings and/or specifications covering other trades shall conform to Division 22 of these Specifications.
- B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Plumbing systems shall be accomplished without additional cost to the Owner.
- C. Furnish all labor and materials required for plumbing service connections to all the various items of equipment requiring plumbing or piping throughout the project shown on the Contract Drawings (even if not shown on Plumbing Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 PLUMBING DIVISION INDEX

220500 GENERAL PLUMBING REQUIREMENTS
220523 VALVES
220700 PIPING INSULATION
221000 PIPE AND PIPE FITTINGS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 22 00 00

SECTION 22 05 00 - GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General Plumbing Requirements specifically applicable to Division 22 sections in addition to Division 1 - General Requirements.
- B. Scope:
 - 1. The work covered by this division consists of performing all operations in connection with the installation of heating, cooling, ventilating, and plumbing including site utility work as indicated under this section. This entire section applies to all mechanical work and all mechanical sections of these specifications. This Contractor shall read and comply with all sections of these specifications including all General and Special Conditions.

1.2 REFERENCES

- A. Standard Requirements:
 - 1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. All work shall be executed in accordance with the local and state codes, ordinances, and regulations governing the particular class of work involved. This Contractor shall be responsible for the final execution of the work under this heading to suit these requirements. In the event of a conflict between the various codes and standards, the more stringent shall govern. Where these specifications and accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect/Engineer. The Architect/Engineer shall prepare any supplementary drawings required, illustrating how the work may be installed so as to comply. On approval of the change by the Architect/Engineer, the Contractor shall install the work in a satisfactory manner without additional cost to the Owner. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved, and on completion of the work, this Contractor shall obtain and deliver to the Owner final certificates of acceptance. This Contractor shall furnish copies of each certificate to the Architect/Engineer.
- C. The Contractor shall secure all permits and licenses for his work and shall pay all fees in connection with such permits and licenses.
- D. The contractor shall hold and save the Owner free and harmless from liability of any nature or kind arising from his failure to comply with codes and ordinances.
- E. Any and all meter deposits and all utility extension costs shall be paid by the Contractor whose work is done in connection with the service that the meter is connected to.

F. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

1. AGA American Gas Association
1515 Wilson Boulevard
Arlington, VA 22209
2. ANSI American National Standards Institute
1430 Broadway
New York, NY 10018
3. ASHRAE American Society of Heating Refrigerating and Air
Conditioning Engineers
345 East 47th Street
New York, NY 10017
4. ASME American Society of Mechanical Engineers
345 East 45th Street
New York, NY 10017
5. ASPE American Society of Plumbing Engineers
960 Illuminating Building
Cleveland, OH 44113
6. ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103
7. AWWA American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235
8. AWS American Welding Society
2501 NW 7th Street
Miami, FL 33125
9. CISPI Cast Iron Soil Pipe Institute
1499 Chain Bridge Road
McLean, VA 22101
10. FM Factory Mutual System
1151 Boston-Providence Turnpike
Norwood, MA 02062
11. FS Federal Specification
General Services Administration
Specifications and Consumer Information Distribution
Section (WFSIS)
Washington Navy Yard, Building 197
Washington, DC 20407
12. NBFU National Board of Fire Underwriters
5530 Wisconsin Avenue, Suite 750
Chevy Chase, Maryland 20815
13. NEC National Electric Code (of NFPA)
14. NEMA National Electrical Manufacturer's Association
2101 L Street, NW
Washington, DC 20037
15. NFPA National Fire Protection Association
Battery March Park

- 16. NSF Quincy, MA 02269
National Sanitation Foundation
Box 1468
Ann Arbor, MI 48106
- 17. OSHA Occupational Safety and Health Administration
U.S. Department of Labor
- 18. PDI Plumbing and Drainage Institute
5342 Boulevard Place
Indianapolis, Indiana 46208
- 19. TIMA Thermal Insulation Manufacturers Association
Technical Services
1420 King Street
Alexandria, VA 22314
- 20. UL Underwriters Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062

- G. Underwriters Laboratories Inc. (UL): All materials, appliances, equipment, devices or appurtenances shall conform to the applicable standards of Underwriters Laboratories Inc., where such standards have been established.

1.3 DRAWINGS

- A. Drawings and specifications shall be considered as cooperative, and work or materials called for by one and not mentioned in the other, or vice versa, shall be done and furnished as though treated by both.
- B. In the cases of discrepancies in figures, drawings, or specifications, the Architect/Engineer shall be notified immediately, and his decision shall determine the necessary adjustment. Without such decision, said discrepancies shall not be adjusted by the Contractor save only at his expense, and, in case of any settlement or any complication arising from such adjustment to the Contractor, he shall bear all extra expense involved.
- C. Should it appear that the work intended to be done, or any of the matters relative thereto, are not sufficiently detailed or explained on the drawings or specifications, the Contractor shall apply to the Architect/Engineer for such further drawings or explanations as may be necessary, allowing a reasonable time for the Architect/Engineer to supply same, and the Contractor shall conform to same as part of the Contract.
- D. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, reference shall be made to the Architect/Engineer whose decision shall be final and conclusive. No alleged oral admission, condonation, or inadvertent neglect on the part of the Architect/Engineer will be accepted as an excuse for inferior work.
- E. The mechanical plans do not give exact details as to elevations of ductwork and piping, exact locations, etc., and do not show all offsets, control lines, pilot lines, and other installation details. The Contractor shall carefully lay out his work at the site to conform to the structural conditions, provide proper grading of lines, to avoid all obstructions, to

conform to details of installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated, satisfactory operational installation.

- F. Should the particular equipment which any Bidder proposes to install, require other space conditions than those indicated on the drawings, the Bidder shall arrange for such space with the Architect/Engineer before submitting his bid. Should changes become necessary on account of failure to comply with these details, the Contractor shall make such necessary changes at his (the Contractor's own expense).
- G. The Contractor shall submit working scale drawings of all his apparatus and equipment which in any way varies from these specifications and plans which shall be checked by the Architect/Engineer and approved before the work is started, Contractor before work proceeds. Interference with structural conditions shall be corrected by the Contractor.
- H. All equipment shall be installed in accordance with the manufacturer's recommendations. Provide all accessories and components for optimum operation as recommended by the manufacturer.
- I. Utilities: The location, size, and pressure of utility lines are shown in accordance with the data given this office by others. As Architect/Engineers, we cannot and do not guarantee the accuracy of this data. Each Bidder shall check and verify this data. The points of connection to utility lines are approximate only and shall be verified by each Bidder prior to submitting his Bid.
- J. Site visit: The Contractor shall visit the site prior to bidding and satisfy himself as the conditions under which the mechanical systems are to be installed. No subsequent allowance shall be made in his behalf for failure to make such a visit. Contractor shall examine all work noted under the demolition drawings and all new work and shall satisfy himself as to the extent of work required to be completed.

1.4 SYSTEM DESCRIPTIONS

- A. Not Used.

1.5 PRIOR APPROVALS

- A. Each equipment item for which the Contractor desires to install equipment other than the specific item identified in the equipment schedule or equivalent equipment by manufacturers specifically named in the schedule, the Contractor shall bear full responsibility to prove to the Engineer that the furnished equipment is equivalent to or better than the specified item. Failure to provide such proof will result in rejection of the shop drawing submittal by the Engineer. Prior written or verbal approval by the Engineer of equipment by other manufacturers will not relieve the Contractor of responsibility to provide equivalence. Prior approval is required, however, any prior approval given is intended only to provide preliminary agreement that the alternate manufacturer may make equipment that complies with the specification requirements and not that all equipment manufactured by him is acceptable.

1.6 SHOP DRAWINGS

- A. Shop drawings or fully descriptive catalog data shall be submitted by the Contractor for all items of material and equipment furnished and installed under this Contract. This shall include piping, ductwork, mechanical equipment, plumbing equipment, control items, etc. The Contractor shall submit to the Architect/Engineer a sufficient number of copies of all such shop drawings or catalog data to provide him with as many review copies as he may need, plus three (3) copies for retention by the Architect/Engineer. No materials or equipment shall be installed until officially approved by the Architect/Engineer.
- B. Before submitting Shop Drawings to the Architect/Engineer for review, the Contractor shall examine them and satisfy himself that they are correctly representative of the material or equipment to which they pertain. The Contractor shall so note these Drawings before submitting them. The Contractor's review of Shop Drawings is not intended to take the place in any way of the official review of the Architect/Engineer, and the Shop Drawings which have not been reviewed by the Architect/Engineer shall not be used in fabrication or installing any work.
- C. The review of Shop Drawings or catalog data by the Architect/Engineer shall not relieve the Contractor from responsibility for deviations from the plans and Specifications unless he has, in writing, specifically called attention to such deviations as the time of submission and has obtained the permission of the Architect/Engineer thereon, nor shall it relieve him from the responsibility for error of any kind in Shop Drawings. When the Contractor does call such deviations to the attention of the Architect/Engineer, he shall state in his letter whether or not such deviations involve any extra cost. If this is not mentioned, it will be assumed that no extra costs are involved for making the change.
- D. After receiving approval on the make and type of materials, the Contractor shall order such materials in sufficient time so that no delay or changes will be caused. This is done to facilitate progress on the job and failure on the part of the Contractor shall render him liable to stand the expense of any and all delays occasioned by failure on this part to provide necessary details. All shop drawings shall be delivered to the Architect/Engineer's office within thirty (30) days from the date of the contract.
- E. Shop drawings will be returned unchecked unless the following information is included: reference to all pertinent data in the Specifications or on the drawings, size and characteristics of the equipment, name of the project and a space large enough to accept an approval stamp. The data submitted shall reflect the actual equipment performance under the specified conditions and shall not be a copy of the scheduled data on the drawings.

1.7 SUBMITTALS

- A. Submittal data shall be organized in commercial quality, three ring binders with durable and cleanable covers. Product information for each piece of equipment shall be separated by an indexing leaf with clear tabs. The product name and symbol (i.e. AHU/Air Handling Unit) shall be typed on white paper inserts and placed in appropriate tab. Complete data must be furnished showing performance, quality, and dimensions. A signed review by the Architect/Engineer must be obtained before purchasing any equipment.

- B. The following items shall be submitted for review by the Architect/Engineer but are not limited to:
1. Pipe Insulation
 2. Coils
 3. Plumbing Fixtures and Trim
 4. Cross Connection Control Devices
 5. Pumps
 6. Hydronic Air Control Devices
 7. Plumbing Equipment
 8. Heat Exchangers
 9. Flexible Pipe Connections
 10. Heating Terminal Equipment
 11. Roof Top Equipment
 12. Radiant Heating Equipment
 13. Vibration Equipment and Calculations

1.8 QUALITY ASSURANCE

- A. General: Comply with Division 1.
- B. Welder Qualifications: Welders shall be certified by the American Society of Mechanical Engineers (ASME) National Certified Pipe for the type of work being performed. Current operators' certificates in accordance with ASME standards shall be on file at the site and shall be available to the Architect/Engineer for examination. Coupons shall be available for review by the Architect and Engineer.
- C. Locations of all pipes, ducts, outlets, appliance, etc., as shown on the drawings, are approximate only and are understood to be subject to such revisions as may prove necessary or desirable at the time the work is installed. Each Contractor will be required to install his work with relation to existing building conditions and shall be entirely responsible for the correctness of his work with reference to finished elevations, etc. Piping shown on the drawings is diagrammatic only and their exact locations, depths, and invert elevations shall be as required for proper flow and coordination with other trades.
- D. The contract drawing depicts graphically the arrangement of piping and ductwork. Should local conditions necessitate a rearrangement, or if any of the piping or ductwork can be installed to better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit three (3) copies of Drawings of the proposed arrangement for the Architect/Engineer's review.
- E. If the Contractor proposes to install equipment, including piping and ductwork, requiring space conditions other than those shown, or to rearrange the equipment, he shall assume full responsibility for the rearrangement of the space and shall have the Architect/Engineer review the change before proceeding with the work. The request for such change shall be accompanied by Shop Drawings of the space in question.
- F. Each Contractor is responsible for the proper location and size of all slots, holes, or openings in the building structure pertaining to his work, and for the correct location of pipe sleeves.

- G. Each Contractor shall coordinate his work with that of all other trades that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines which require a stated grade for proper operation. Drainage lines shall take precedence over water lines in determination of elevations. In all cases, lines requiring a stated grade for their proper operation shall have precedence over electrical conduit and ductwork.
- H. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Lubricate all equipment properly in accordance with manufacturer's instructions. Furnish zerk grease fittings on all greaseable bearings.
- I. Equipment and Materials: The materials and equipment shall be new and shall be the standard products of the manufacturers regularly engaged in the production of Plumbing, Heating, Cooling, Ventilation, and Fire Protection Equipment, and shall be the manufacturer's latest standard design. Where two or more units of the same class of equipment are required, these units shall be the products of the same manufacturer. However, the component parts of the systems need not be the products of the same manufacturer. Specific equipment specified hereinafter is to be considered a standard of quality and operation. In general, all capacities of equipment, and motor and starter characteristics are shown in schedules on the drawings. Reference shall be made to the schedules for specific information. The capacities shown are minimum capacities. Variations in the characteristics will be permitted only on written approval of the Architect/Engineer. All equipment shall be shipped to the job with not less than a prime coat of paint or as specified hereinafter. Insofar as is possible all items of the same type (i.e., pumps, fans, etc.) shall be by the same manufacturer. Where installation instructions are not included in these specifications or on the plans, the manufacturer's instructions shall be followed. All equipment affected by altitude shall be rated to operate at the altitude where it is to be installed.
- J. Excavation and Backfilling: This Contractor shall do all necessary excavation and backfill for the installation of the Mechanical systems as may be required. Curb cuts, asphalt, and concrete patching, cutting, and patching existing floor, etc., shall be part of this Contractor's responsibility. No extra payment will be made for rock excavation. Trenches for all underground piping shall be excavated to the required depths. The bottoms of trenches shall be tamped hard and graded to secure maximum fall. Bell holes shall be excavated to assure the pipe resting for its entire length on solid ground. Should rock be encountered, it shall be excavated to a depth of 6 inches below the bottom of the pipe, and before laying the pipe, the space between the bottom of the pipe and the rock surface shall be filled with gravel, thoroughly tamped. Pipe laid in trenches dug in fill shall be supported down in the trenches and shall be filled. No roots, rocks or foreign materials of any description shall be used in backfilling the trenches. The backfill material shall be identical to the surrounding fill material and shall be placed in 6-inch layer, wetted, and compacted to the density of the adjacent soil. See Division 2 for additional information for site utilities. All surplus materials shall be hauled from the project by the Contractor at his expense.
- K. Cutting and Repairing:
1. Responsibility of the Contractor whose work is involved. Coordinate with others to prevent unnecessary cutting and repairing.

2. Lay out and locate equipment, openings, and chases. Install sleeves, inserts, and supports. Arrange with those whose work is involved to do cutting and replacing caused by negligence or error with costs reimbursed by the Contractor at fault. Cutting and replacing of existing work shall be the responsibility of the Contractor whose work is being installed.
 3. Removal or terminating connections of existing work which is abandoned or replaced shall also be done hereunder to provide correct and finished work.
- L. Foundations: All equipment shall be provided with suitable foundations and supports. It shall be the responsibility of the Contractor to provide for the proper locations of these foundations and supports. This applies to all rooftop equipment also.
1. All concrete foundations required by equipment furnished by the Mechanical Contractor shall be constructed by them (except where otherwise noted) the conformity with the recommendations of the manufacturer of the respective equipment, and with the approval of the Architect/Engineer. All corners of the foundations shall be neatly chamfered. Foundation bolts shall be placed in the forms when the concrete is poured. Allow 1 inch below the equipment base for alignment, leveling and grouting with nonshrinking grout. Grouting shall be done after the equipment is leveled in place. After the grout has hardened, the foundation bolts shall be pulled up tight and the equipment shimmed, if necessary. After removal of the forms, the surface of the foundation shall be rubbed.
 2. Unless otherwise noted, foundations shall be a minimum of 6-inch high. All concrete work performed by these Contractors shall conform entirely to the requirements of the Concrete Specifications which describe this class of work.
- M. Code Requirements: Comply with state and local code requirements and ordinances. Call for inspections required by responsible building inspection authority.
- N. Applicable Building Codes and Ordinances: Including the latest edition of each code, but not limited to the following:
1. International Building Code.
 2. Uniform Mechanical Code.
 3. Uniform Plumbing Code.
 4. Governing Fire Department Requirements
 5. Utility Company Requirements
 6. National Fire Protection Association Standards
 7. NFPA 70 - National Electrical Code
 8. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
 9. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems
 10. NFPA 13 - Sprinkler Systems
 11. NFPA 101 - Life Safety
 12. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment
 13. International Energy Conservation Code 2018
- O. Access Panels

1. Similar to Milcor, or as noted on the drawings, size as required for concealed expansion joints, valving, gauges, balancing dampers, valves, traps, pitot stations, equipment and similar items requiring accessibility. Notify the General Contractor of each access panel location and the required size. Panels shall be proper type for ceiling or wall in which they are installed. The panels shall be furnished under this section of the Specifications, unless otherwise directed, but shall be coordinated to be compatible with walls and ceilings furnished under other sections.

1.9 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Division 1.
- B. Large Items: Make arrangements with other trades on the job for introduction into the building of equipment too large to pass through finished openings.
- C. Acceptance: Check and sign for materials to be furnished by others for installation under Division 22 upon delivery. Contractor shall be responsible for the storage and safekeeping of such materials from time of delivery until final acceptance.
- D. Protection: Close ends of pipe at the close of each working day during construction to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Protect fixtures and equipment against damage during mechanical work with heavy paper or plastic until final clean-up.
- E. Storage: Store equipment in covered enclosure or wrap with weather tight 6 mil Visqueen.
- F. Shipping Protection: Protective casings, crating, and coverings to remain in place until start-up of equipment.

1.10 PROJECT CONDITIONS

- A. Performance: All systems are to be rated at 4,500 ft. elevation.

1.11 SEQUENCING AND SCHEDULING

- A. General: Comply with Division 1.
- B. Schedule: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.
- C. Utility Interruptions: Schedule mechanical utility interruptions with the Architect/Engineer/Owner minimum of seven (7) days prior to the requested outage. Plan work so that duration of the interruptions a maximum of one day.

1.12 CONTROLS WIRING AND ELECTRICAL EQUIPMENT

- A. All mechanical equipment controls wiring, conduit, relays, interlocks, and all accessories required for a completely operational controls system shall be the complete responsibility

of the mechanical contractor. The mechanical contractor has the option to hire the project electrical contractor or any qualified controls contractor to install mechanical controls wiring and conduit. Refer to specification 251000 for installation requirements.

- B. Electrical items such as disconnect switches and motor starters associated with equipment provided by Division 22, when specifically mentioned to be furnished by the Mechanical Contractor, whether in these specifications or on the Electrical or Mechanical Drawings, shall be furnished by the Contractor. These items shall be mounted and connected as required for a completely operational system. See Control Systems Specification for further information.
- C. All electrical equipment characteristics (voltage, etc.) must be verified by the Contractor prior to ordering. If the Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, he shall first inform the Architect/Engineer of the change and shall then coordinate the change with the Electrical Contractor and shall pay all additional charges in connection with the change.
- D. All motors shall meet all the requirements of all Electrical Divisions.
 - 1. All motors shall be built in accordance with the current applicable IEEE, ASA, and NEMA standards. All general-purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. All motors shall have copper windings. All motors to have minimum power factor of 85% or have switched correction to 90%. Unless indicated otherwise, motors shall be NEMA design B with a service factor of 1.15 with 40°C rise and total temperature rise of 65°C ambient and when powered from the system voltage feeding the motor. TEFC motors shall a service factor of 1.00 with total temperature is of 65°C in the above conditions. Motors located in areas exceeding 40°C ambient shall be factory-rated for the ambient temperature of the motor environment. Single phase motors shall generally be NEMA Type N split phase induction motors with built-in thermal protectors. Single phase motors connected on loads requiring high starting torque shall be capacitor-start induction motors. Single phase motors of 1/10 HP or less may be shaded pole induction motors.

1.13 PROTECTION AGAINST HAZARDOUS CONDITIONS

- A. The Contractor shall take precautions against hazardous construction conditions at all times during construction. The final condition of the facilities shall be safe, and where safety to operating personnel is jeopardized, suitable signage shall be posted.
- B. Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operating personnel, shall be cut back and/or protected to reduce the risk of injury. All openings between floors shall be protected with barriers around the openings, gratings across the openings, or steel bars through the openings to avoid and protect against injury.

1.14 HAZARDOUS SIGNS

- A. Equipment room contains moving or rotating parts, floor openings, or other potentially hazardous environments and shall include a sign on the door entering it that shall read similar to the following: **Hazardous Area - Authorized Personnel Only.**

1.15 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. The Mechanical Contractor shall furnish to the Owner a bound (three (3) ring binder) manual in triplicate, containing complete repair parts lists, and operating, service, and maintenance instructions on all mechanical equipment, fixtures, and systems, as noted below:
1. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect/Engineer, Sub-consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
 2. For Each Product System: List names, addresses and telephone numbers of Sub-contractors and suppliers, including local source of supplies and replacement parts.
 3. Product Data: Mark each sheet to clearly identify specific product and component parts, and data applicable to installation. Delete inapplicable information.
 4. Warranties and Bonds: Bind in copy of each.
 5. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
 6. Include color-coded wiring diagrams as installed for control system.
 7. Operating Procedures: Include start-up, break-in and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.
 8. Maintenance Requirements: Include routine procedures and guide for troubleshooting, disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 9. Provide servicing and lubrication schedule and list of lubricants required.
 10. Include manufacturer's printed operation and maintenance instructions.
 11. Include sequence of operation by controls manufacturer.
 12. Provide original manufacturer's part list, illustrations, assembly drawings and diagrams required for maintenance.
 13. Provide control diagrams by controls manufacturer as installed.
 14. Provide charts of valve tag numbers, with locations and functions of each valve, keyed to flow and control diagrams.
 15. Provide list of original manufacturer's spare parts and recommended quantities and to be maintained in storage.
 16. Include Test and Balance (T&B) Reports as specified in Section 230593.
- B. The Mechanical Contractor shall also provide training as required by Section 230100 to the Owner's operation and maintenance personnel.

1.16 OPERATION PRIOR TO ACCEPTANCE

- A. The Owner shall have the right to operate any and all apparatus as soon as and as long as it is in operating condition, after Owner personnel have received operational training, whether or not such apparatus has been accepted as complete and satisfactory, except that this shall not be construed to mean operations before any required alterations or repairs have been made. This operation does not indicate acceptance of the equipment by the Owner. When the Contractor enters into a contract with the Owner, he agrees to the above.

1.17 WARRANTY AND SERVICE PROGRAM

- A. Due to the critical performance requirements and to clearly establish warranty responsibility for this project, the Contractor shall provide a full-service maintenance and warranty program to the Owner for one full year after beneficial occupancy (substantial completion).
- B. This service program shall be included as part of the base bid and shall include service, maintenance, repair, replacement, lubrication, temperature control calibration and repairs, and documenting proof for all service and maintenance work on all equipment and system furnished by the Contractor.
- C. A single representative in the employment of the Contractor shall be responsible for coordination and follow through of this program. This representative's name and phone number shall be submitted to the Owner as part of the maintenance manuals and supportive data. The Contractor shall respond to a request for service with 24 hours if so requested.
- D. During this first year of operation, the following sequence of maintenance service shall be performed as a minimum.
 - 1. Clean strainers in piping.
 - 2. Fans and/or pumps be lubricated and oiled once every four (4) months.
 - 3. Controls shall be calibrated throughout the facility at the end of six (6) months (following substantial completion). Any leaks in the piping systems shall be repaired.
 - 4. All equipment manufacturer's service recommendations shall be followed during this period.

1.18 FLUSHING AND DRAINING

- A. It shall be the responsibility of this Contractor to properly drain and flush all ducts and pipes before use or acceptance to ensure that all debris is completely removed. Damage caused by such debris remaining in the ducts or pipes shall be repaired by this Contractor at his expense. This Contractor shall demonstrate to the Architect/Engineer's representative that all piping is clean.

1.19 CLEANING

- A. This Contractor shall remove from the building construction site all rubbish and dirt as it accumulates under the contract. At completion, all areas shall be broom cleaned and all obstructions, surplus materials, etc., removed.

1.20 GUARANTEE

- A. The Contractor shall guarantee all materials, equipment, and workmanship furnished and installed by him under this Contract, to be free from all defects of workmanship and materials, and shall agree to replace at his expense, without expense to the Owner, at any time within one year after installation is accepted by the Architect/Engineer, any and all defective equipment, parts, etc., that may be found. (This excludes normal maintenance and daily servicing of equipment which is the Owner's responsibility.)

1.21 FLOOR, WALL, AND CEILING PLATES

- A. Where exposed pipes pass through floors, finished walls, or finished ceiling, they shall be fitted with chromium-plated escutcheons of an approved pattern. Escutcheons and plates in Mechanical Rooms do not require chrome finish.
- B. This Contractor shall be responsible for providing and installing all counter flashing. All openings in the roof shall be flashed and counterflashed. Use four-pound lead flashing materials for all vent lines and welded flashing in steel lines passing through roof. The Mechanical Contractor shall notify the General Contractor where each roof penetrations are and the size of the opening.

1.22 PIPE SLEEVES

- A. Schedule 40 steel pipe sleeves or pipe sleeves made of No. 20 gauge galvanized steel, properly secured in place with approximately 1/4" space between each sleeve and the surface of the pipe and/or insulation passing through it, shall be provided for all pipes passing through concrete floors, roofs, and masonry walls. All pipe sleeves shall be fixed in place as the walls and floors are built up. The Contractor shall furnish and locate all sleeves and pipes passing through concrete floors, exterior masonry walls, and roofs shall be made watertight with approved non-hardening plastic material. Sleeves through pipe chase or equipment room floors shall project a minimum of 2-inch above the floor and shall be of black steel pipe with waterproof flange at center of floor thickness. Each sleeve through a fireproof wall shall be packed with approved fireproof rope in the annular space.

1.23 PIPE HANGERS

- A. Pipe hangers shall be Fee and Mason of a type suitable for each use. Perforated straps shall not be used in any work. For ferrous pipes up to and including 4 inch in size, use Fee and Mason Fig. 199 malleable iron, adjustable, split ring, swivel hanger. For plumbing piping larger than 4 inches, use Fee and Mason Fig 239 steel clevis hanger. Where several pipes are parallel at the same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be supported on rollers where indicated on the Drawings. For copper pipes up to and including 3 inch in size, use Fee and Mason

Fig. 360 malleable iron, copper plated hangers. For copper pipes larger than 3 inches, use Fee and Mason Fig. 364 copper plated clevis hanger.

B. Hanger rod sizes shall conform to the following schedule:

1.	Pipe up to and including 2"	3/8" rods
2.	Pipe 2-1/2", 3" and 3-1/2"	1/2" rods
3.	Pipe 4" and 5"	5/8" rods
4.	Pipe 6"	3/4" rods

C. Unless shown otherwise on the Plans, all horizontal runs of ferrous piping shall be suspended from the floor or roof construction, as the case may be, by means of hangers with the following spacing:

1.	Pipe up to and including 1-1/4"	8'
2.	Pipe 1-1/2" and 2"	10'
3.	Pipe 2-1/2" and 3"	12'
4.	Pipe 3 1/2" and 4"	14'
5.	Pipe 5" and 6"	16'

D. Unless shown otherwise on the Plans, all horizontal runs of copper piping shall be suspended from the floor or roof construction as the case may be, by means of hangers with the following maximum spacing:

1.	Pipe up to 3/4" in size	5'
2.	Pipe 1" and 1-1/4"	6'
3.	Pipe 1-1/2" and larger	10'

E. There shall be a hanger within 2 inches of each elbow or tee. Additional supports shall be provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length of pipe. Vertical risers shall be supported by approved riser clamps at each floor. Vertical pipes within a space shall have not less than two supports.

F. Supports and hangers shall be installed to permit free expansion and contraction in the piping systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to control expansion and contraction, the piping shall be guided and firmly anchored. No piping shall be self-supporting, nor shall it be supported from equipment connection.

G. Expansion bolts shall be Ackerman-Johnson or Hilti.

H. Beam clamps suitable for use with this type of steel construction involved shall be Grinnell.

1.24 PRESSURE VESSEL CERTIFICATION

A. Not used.

1.25 ISOLATION

- A. Excessive vibration or objectionable noise created in any part of the building by the operation of any equipment furnished and/or installed under the Mechanical Contract will be extremely objectionable and the Contractor shall take all precautions against the same by isolating the various items of equipment from the building structure and by such other means as may be necessary to eliminate all excessive vibration and objectionable noise produced by any equipment installed by them, and consequently, they shall design all foundations, supports, etc., for their equipment, and all piping with this end in view. In addition, these Contractors shall supervise the construction of all foundations and supports, whether they build them or not, in order that they may be constructed in such a manner as to prevent the transmission of objectionable noise and/or excessive vibration. Submit calculations on all vibration isolation equipment.
- B. All equipment having moving parts shall be isolated from the building structure by means of Korfund isolation materials, unless specifically noted otherwise. All isolators shall be the same brand and shall be supplied from the same source. Equipment manufacturer's recommendations shall be followed in the isolation of equipment.
- C. Vibration isolators shall have sufficient resilience to meet the following minimum efficiencies:

<u>Motor HP</u>	<u>Equipment Room</u>
Up to 5	90%
7-1/2 to 15	93%
20 to 40	95%
50 to 100	97.5%

- D. Spring isolators shall be of the housed type with ribbed pads bonded to the underside of the baseplate or may be unboxed stable springs. Isolators shall be furnished with snubbers and limit stops where so recommended by the equipment manufacturer.
- E. The Supplier of the isolating equipment shall, upon completion of the job, check all isolating materials and verify that they are installed properly, and submit a report in writing to the Architect/Engineer.

1.26 TESTING

- A. Before completion of this project, the Mechanical Contractor shall test all materials and equipment which normally require testing. All piping, etc., shall be tested to meet code requirements or the Specification requirements, whichever is more stringent.
- B. All equipment shall be operated sufficiently long enough to prove to the Architect/Engineer that the equipment performs satisfactorily and meets the requirements set forth on the Plans or in these Specifications.

1.27 CERTIFICATIONS

- A. Before receiving final payment, the contractor shall verify that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these Specifications. Submit certifications and acceptable certificates to the Architect/Engineer.

1.28 GENERAL PIPING INSTALLATION REQUIREMENTS

- A. Provisions for Drainage: All piping systems shall be installed so that they may be easily drained. Drain caps, plugs, or hose bibbs shall be installed at low points. Grade piping toward drain locations.
- B. Alignment: All installed pipelines shall be straight and shall remain straight against strains. Proper allowance shall be made for expansion and contraction.
- C. Clean as Installed: All piping shall be kept free from scale or loose dirt when installed and must be kept clean during the completion of the installation. All openings in the piping system shall be capped or plugged while awaiting further connections. All detergents, solvents and other cleaning agents shall be compatible with the materials of fabrication of the system in which they are used. They shall not adversely affect the materials of mechanisms in the systems and they shall be acceptable to equipment manufacturers. All detergents, solvents, and other cleaning agents shall also be compatible with the process streams to be handled by the systems in which they are used.
- D. Insulated Fittings: Install between any dissimilar metals such as steel and copper.
- E. Expansion and Contraction: The Contractor shall make all necessary provisions for expansion and contraction with proper fittings, anchors, dresser couplings, loops, etc. Install flexible connectors on each pipe at each building expansion joint.
- F. Welding: Refer to Paragraph 1.29 of this section of these specifications.
- G. Bending: No bending of pipe will be permitted.
- H. General: The installation shall be coordinated with respect to space available with heating, cooling, ventilating, and electrical installation. In every instance where there is a conflict in the routing of the piping and the ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows, shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Cutting or weakening of structural members to facilitate piping, installation is not permitted. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall be run parallel with the lines of the building unless otherwise noted on the drawings. Unless otherwise shown on the drawings, horizontal piping shall pitch down in the direction of flow with grade of not less than 1 inch in 40 feet. Piping connections to equipment shall be in accordance with details shown on the drawings or as recommended by the equipment manufacturer. Service pipe valves and fittings shall be kept a sufficient

distance from other work to permit finished covering not less than 1/2 inch from such other work, and not less than 1/2 inch between finished covering on the different services.

- I. Installation of Valves: Valves shall be installed at the locations shown on the drawings and where specified and where directed at site. Gate valves shall be used unless otherwise shown, specified, or directed. All valves shall be installed with their stems horizontal or above. Where tight shutoff is required, a composition seat globe valve or resilient seat ball valve shall be used.
- J. All valves which must be used during operation, all control valve assemblies, instrument control cases, liquid level controls, gage glasses, orifices, relief valves, and other equipment which must be observed, adjusted, or serviced during operation shall be located conveniently accessible from an operating platform or grade.
- K. In general, relief valves within processing unit limits shall be located conveniently accessible from an operating platform or grade.
 - 1. Those in non-hazardous service, such as water, shall discharge directly to outside.
 - 2. Relief valves should have no piping between the vessel or line and the valve inlet, except as shown on the drawings.
 - 3. Relief valves shall be installed in a vertical position. Vent piping shall be braced and supported in a manner that will not produce excessive stresses in the relief valve and will permit removal of the relief valve without necessary temporary supports for the vent lines.
- L. Equipment Connections: All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment. The contractor shall be required as directed to remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected. Pipe connections to equipment shall be made with unions or flanged fittings. Provide removable headers for large equipment for service access.
- M. Joints
 - 1. Flanged Joints: All flanged joints shall be face matched. Raised face flanges shall not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be turned off. All flanged bolt holes shall straddle the horizontal and vertical center line unless otherwise noted.
 - 2. Screwed Joints: Screwed pipe joints shall have American Standard Taper Pipe Threads ANSI-B2.1 Latest Edition. Burrs formed when cutting pipe shall be removed by reaming. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. Joints shall be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound.
 - 3. Solder-Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool or wire brush before seating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for serrated fittings on water, compressed air below 60 psig, and vacuum lines shall be made with a 95 percent

tin and 5 percent antimony. Cored solder or solder containing lead will not be permitted.

- N. Reducers: Reduction in pipe size shall be made with one piece reducing fittings. Bushings reducing at least two pipe sizes will be acceptable only when there is no room for reducing couplings or swaged nipples.
- O. Unions: All piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings specified with which they are used. Union Pressure classes and end connections shall be the same as the fittings used in the lines with the unions. Steel unions shall have hardened stainless steel seating surfaces on both faces.
- P. Hanger Supports:
 - 1. All hanger rods used to support piping, conduit, mechanical units, equipment, trapezes, and other items shall be straight and installed plumb, regardless of length. Do not bend rods to adapt to sloped or rotated structural members, secondary support members or to sloped mounting holes on supported equipment. Contractor shall utilize available swivel, hinged, or rigid mounting techniques designed to accommodate a slope or rotation, or shall design a custom solution. Selected techniques for each application shall be submitted for approval prior to use.
 - 2. Do not bend rods to circumvent an obstruction.
 - 3. Loads on hanger rods shall be applied in direct tension. Do not apply compression, lateral or moment loads to hanger rods. Install bracing or additional supports to prevent hanger rod from incurring non-tension loading.
 - 4. Do not create offsets in rods; use only in-line couplers, and only when length of coupled rod exceeds standard available length (typically 12 feet), or when full lengths cannot be placed in position. Provide additional horizontal bracing to prevent swaying of supported piping or equipment.
 - 5. Do not straighten bent rods for subsequent use. If a rod becomes bent, cut off and discard the bent portion. Remaining straight portion of rod may be used.

1.29 WELDING

- A. All welding of piping covered by this specification, regardless of condition of service shall be accompanied as follows:
 - 1. The welding shall be in accordance with the recommendations of the American Welding Society. Mitering of pipe to form elbows, notching to form these, or any similar construction will not be permitted. Welding fittings shall be installed on all welded lines. Joints to be welded shall be properly aligned and spaced, using special welding clamps where necessary. All welders to be employed shall have passed qualification tests prescribed by the National Certified Pipe Welding bureau (or by another reputable testing laboratory or agency) using procedures approved by the American Society of Mechanical Engineers or the American Welding Society. The welders will be required to pass qualification tests when the work of the welder creates a reasonable doubt as to his proficiency. Tests shall be conducted at no additional expense to the Owner.

2. Each welder shall, in addition to having passed the prescribed qualification tests (as noted in Paragraph 1.30.A.1), prepare sample coupons at the job site on a portion of pipe that is cut such that the cross section of the weld is opened to view. The sample weld should be prepared using a 6 inches diameter pipe. The sample shall reflect a continuous weld with perpendicular cut out to show the weld in cross sectional view. This sample, when accepted and approved by a certified welding inspector, shall be used as a standard of quality to compare to other welds that this welder will be performing on the job. This same sample weld will also be a basis for accepting or rejecting the welder for working on this project. The sample weld shall be identified with a date and the welder's name and shall be kept at the site throughout the project.
3. All welding on pressure piping shall conform to all of the requirements of the American Society of Mechanical Engineers Code for Pressure Piping - B31.1 (An American National Standards Institute publication), as defined in the latest edition of the ANSI Power Piping B31.1 Manual. All welding shall also conform to all of the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. All chapters, current addenda and supplements of these manuals shall apply. This code shall be used to establish standards of performance and quality of welds. However, the Owner reserves the right to perform radiographic testing of all welds, to compare any of the welds to the approved "standard" sample welds of each welder, and to compare the welds to the welding diagrams and sketches of those recommended in the ANSI B31.1 Power Piping Manual. The intent is to obtain the highest quality welding job possible. The cost of any initial radiographic testing, for random inspection, shall be paid for by the Owner. If radiographic random testing reveals that a weld is defective, the Contractor shall bear the cost of all repairs and re-testing necessary to be made to subject weld until conformance with radiographic tests is reached. The potential for random radiographic testing and welding quality control applies to all pressure piping systems in this project, including systems below 100 psig. If a question should arise regarding the possibility of faulty welding or if there are obvious visual defects in the welding, the Contractor shall be required to correct such deficiencies to a quality level consistent with the recommendations, welding diagrams and sketches in the ANSI B31.1 Manual. The quality level shall also reflect that of the approved sample welds accomplished by each welder for this particular project.

1.30 TESTING FOR PIPING SYSTEMS

- A. General: Before insulation is applied, all piping, equipment, and accessories installed under this contract shall be inspected and tested by the Contractor. All labor, material, and equipment required for testing shall be furnished by the Contractor. The Contractor shall be responsible for all repairs and retesting as required. All instruments and other equipment whose safe pressure range is below that of the test pressure shall be removed from the line or blanked off before applying tests. Prior to performing tests, all lines shall be "blown" free of all loose dirt and foreign particles. The lines shall then be thoroughly flushed with water (liquid lines only) at a sufficient flow rate and period of time, to ensure complete cleaning of the lines of all dirt, scale, and foreign matter. Satisfactory flushing of the lines shall be subject to approval. After testing and flushing lines, all filters and strainers shall be cleaned.

- B. Safety: Since the Risk of failure, with the attendant possibility of injury, is appreciable greater with further testing, all safety measures required by codes or ordinance or reasonable applicable to the situation shall be taken.
- C. Concealment: Equipment or piping to be pressure tested shall not be insulated, covered, or concealed prior to that test. Compression joint underground piping may be backfilled prior to pressure test except that joints shall remain exposed until after the test, but tie rods, clamps, etc., shall be in place and fastened.
- D. Pressure Ratings: These tests shall not be used to establish pressure ratings.
- E. System Protection: Protect all piping and equipment against overpressure, collapse from vacuum, and hydraulic shock during the filling, testing, and draining procedures. Seats of iron valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Pressure tests against other closed valves shall not exceed twice the normal rating. Note that where significant differences in elevation exists, there is a risk of overpressure in the lower portions of the system in order to attain test pressure in the upper portion of the system
- F. Test Temperature: Apply test pressure only after the system and test medium are at approximately the same temperature, preferably not less than 60°F. Note that some applicable codes require testing above a specified minimum temperature.
- G. Sectionalizing: Systems may be separated into sub-systems for testing if such action will expedite or simplify the testing.
- H. Temporary Supports: During hydrostatic testing of lines provide temporary supports to prevent oversteering supports or hangers. When tests are completed, remove all temporary supports, locks, stops, etc., and adjust supports for their cold load and alignment.
- I. Testing: Domestic hot and cold-water piping and heating water piping shall be tested hydrostatically at the test pressures specified and shall show no drop in pressure in a 2 hour period. Leaks shall be located by soap testing
 - 1. Test Pressures:
 - a) Natural gas piping: as required by governing code
 - b) Domestic Hot and Cold Water: 100 psig or 50% more than operating pressure, whichever is greater.
 - c) Condenser or Tower Water Supply & Return: 100 psig.
 - d) Heating Water Supply and Return: 100 psig.
 - e) Chilled Water Supply and Return: 100 psig.
- J. Sanitary Waste and Soil System:
 - 1. After all soil and waste pipes and vent stacks have been installed, the outlets shall be plugged, and the piping system filled with water in vertical sections to the highest point of the system and allowed to remain filled for twenty-four (24) hours and shall prove to be leaktight under such conditions. A one-inch drop will be allowed in water level in standpipe. This test may be conducted in segments as

required by the sequence of construction. Contractor shall certify in writing that all tests were satisfactorily completed before piping was concealed and shall submit the certification to the Architect/Engineer for his records and for transmittal to the owner.

K. Test Report

1. A detailed report of pressure tests on piping and equipment shall be forwarded in duplicate to the Architect/Engineer. This report shall show date of test, lines tested, test medium, length of time test pressure was held, pressure drop or rise, and extent of venting or repressurizing.

1.31 COOPERATION WITH OTHER TRADES

- A. The Contractor shall refer to other sections of these specifications covering the work of other trades which must be carried out in conjunction with the mechanical work so that the construction operations can proceed without harm to the Owner from interference, delay, or absence of coordination.

1.32 FIELD MEASUREMENTS

- A. The Contractor shall verify the dimensions covering the mechanical work at the building. No extra compensation shall be claimed or allowed on account of difference between actual dimensions and those indicated on the drawings. He shall examine the adjoining work on which Mechanical work is dependent for maximum efficiency and shall report any work which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting Mechanical work.

1.33 SAFETY GUARDS

- A. The Mechanical Contractor shall furnish and install safety guards required in order to obtain certificates of inspection from all authorities having jurisdiction. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded. Provide coupling guards on all rotating shafts.

1.34 PROTECTION

- A. All work, equipment, and materials shall be protected at all times to prevent obstruction, damage, or breakage. All pipe openings shall be closed with caps or plugs during installation. All equipment shall be covered and protected against dirt, water, chemical, or mechanical injury. At the completion of the work, all equipment shall be thoroughly cleaned, and the entire system shall be delivered in a perfect, unblemished condition.

1.35 PAINTING AND IDENTIFICATION

- A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be marred in transit or during installation, it shall be finished to present a neat, workmanlike appearance.

- B. Except as elsewhere hereinafter specifically required, any painting of equipment, piping, ductwork, grilles, insulation, etc., furnished and installed under this Section of the Specifications will be done by the Painting Contractor. However, the Mechanical Contractor shall leave his equipment clean and free from any grease, dirt, rust, etc., and in suitable condition for painting.
- C. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during the painting operation.
- D. The piping shall be painted the basic color as indicated in other sections of these specifications and shall be marked every 10 feet on centers with Brady pipe markers. Arrows, approximately 6 inch in length and spaced about 10 feet on centers shall indicate the direction of the flow pipe. Locate additional labels as required in Mechanical Rooms. Staple in place, brush with clear lacquer. Markers shall state pipe size, flow direction, and pipe usage (such as "cold water," etc.).

1.36 RECORD DRAWINGS

- A. The Contractor shall, during the execution of the work, maintain a complete set of drawings upon which all dimensional locations of equipment piping and all deviations and/or changes in the work shall be recorded. Water, storm, and drainage mains shall be delivered to the Architect/Engineer in good condition upon the completion and acceptance of the work and before final payment is made.

1.37 SUPPLIER RESPONSIBILITY

- A. Each supplier, whether furnishing equipment as specified or as a substitution shall be responsible for certifying that the equipment is properly installed and that the warranty is valid. Submit written reports on the installation and the equipment performance when requested to do so by the Architect/Engineer (or his representative). Each supplier shall be responsible for furnishing qualified personnel at the job site at anytime requested by the Architect/Engineer (or his representative) during the construction or warranty periods.

END OF SECTION 22 05 00

SECTION 22 05 23 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. All valves except lubricated plug valves and butterfly valves shall be manufactured by Nibco, Hammond, Lunkenheimer, Kennedy, Stockham, Walworth, Powell, or Milwaukee.
- B. Lubricated plug valves shall be as manufactured by Rockwell, Milwaukee, or Walworth.
- C. Butterfly valves shall be as manufactured by W.C. Norris, Centerline, Nibco, Demco, Grinnell, Milwaukee, or Keystone.

1.3 RELATED WORK IN OTHER SECTIONS

220000 PLUMBING INDEX
220500 GENERAL PLUMBING REQUIREMENTS
220700 PIPING INSULATION
230519 PIPING SPECIALTIES
230548 VIBRATION ISOLATION AND EXPANSION COMPENSATION

1.4 IDENTIFICATION OF VALVES

- A. Each valve shall be provided with a stamped metal tag secured to the valve with metal chain. Tag shall indicate both the service and function of each valve. The Contractor shall furnish two prints of drawings showing floor plan for each floor with all valves accurately located and labeled. These drawings shall be neat and easily read.

PART 2 - PRODUCTS

2.1 VALVES

- A. Heating water, chilled water, domestic water, and low-pressure steam (<15 psi):
 - 1. Gate Valves 2" and Under: Nibco No. T134, rising stem, ductile iron hand wheel, union bonnet, solid wedge disc, bronze body, Class 150 psi working pressure.
 - 2. Gate Valves 2-1/2" and Larger: Nibco No. F617-0, bronze trimmed, solid wedge disc, iron body, O.S. & Y., 125 psi working pressure.
 - 3. Swing Check 2" and Under: Nibco No. T433, swing type, Y-pattern, all bronze, renewable seat & disc, regrinding, 200 psi working pressure.
 - 4. Swing Check, 2-1/2" and Larger: Nibco No. F938-31, iron body, bolted bonnet, Class 150, bronze trimmed, check valves installed at discharge of pumps shall be non-slam type.

5. Globe Valves 2" and under: Nibco No. T235, union bonnet, integral seat, Class 150 bronze body with renewable disc.
6. Globe Valves, 2-1/2" and Larger: Nibco No. 718-B, bolted bonnet, cast iron body, 125 psi working pressure O.S. & Y., pattern bronze trimmed.
7. Gate Valves 3" and Under for Copper Pipe: Nibco No. S134, union bonnet, Class 150 bronze rising stem wedge disc.
8. Globe Valves 2" Under for Copper Pipe: Nibco S-235, Class 150, bronze union bonnet, integral seat, renewable seat and disc.
9. Angle Valves 2" and Under Copper Pipe: Nibco T335, Class 150, Union Bonnet, integral seat, renewable seat & disc.
10. Angle Valves 2 1/2" and Larger: Nibco F8180-B, Class 125, bolted bonnet cast iron, renewable seat & disc., bronze trim.
11. Check Valve for 3" and under for Copper Pipe: Nibco S-433, Y-pattern, swing type, all bronze, renewable seat & disc.
12. Manual Balancing Valves:
 - a) 2" and Under: Nibco T-585-70 ball valve or Milwaukee Butterball butterfly valve with calibrated flow set handle.
 - b) 2-1/2" and Larger: W.C. Norris butterfly valves with lever with infinite throttling position as specified below.
13. Circuit Balancing Valves: Balance Valves shall be "Circuit Setter" balance valves as manufactured by Bell & Gossett.
14. Butterfly Valves: Lug type butterfly valves, ductile iron or cast iron body, bronze blade, stainless steel shaft and with EPT liner for tight shutoff up to 150 psi, bonded seat. Valves to be suitable for mounting between flanges, with lugs drilled and tapped so that pipeline can be disconnected with the valve still holding pressure. Valves 3" and smaller to have lever operators with infinite throttling positions. Valves 4" and larger to have worm gear and hand wheel manual operators. Butterfly valves may be used in lieu of gate valves for water service 2" and larger. Liner shall be suitable for -30 F to + 275 F.
15. Ball Valves:
 - a) 1/2" to 2": Nibco No. T-585-70, two-piece body, bronze, screwed ends, Teflon seats, straight through flow design.
16. Lubricated Plug Valves: Rockwell Mfg. Co. "Permaturn" lubricated plug valves Fig. No. 143. Provide valve handle for each valve. Valves shall have tapered plugs with thermally bonded lubricated film.
17. Water Pressure Relief Valves for makeup to heating and cooling systems, and relief for heating and cooling system, Bell & Gossett No. 1170 unless otherwise noted.
18. Relief Valves for hot water generators and heating converters. ASME labled temperature and pressure relief valves shall be installed on the hot water generator. Pressure relief valve shall be installed on the converter set for 30 psi. Valves shall be sized for the full heating capacity. Discharge from valves shall be piped to the nearest floor drain.
19. Drain Valves: Nibco No. T134, 3" and smaller.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All valves shall be installed in locations which will allow easy operation and facilitate maintenance.
- B. Gate and globe valves shall be installed with stems up.
- C. System balancing valves shall be installed where shown or required to balance waterflows to all system components. In general balancing valves shall be provided at the following locations:
 - 1. Each pump discharge, lubricated plug valve.
 - 2. Each main branch circuit, circuit balancing valve.
 - 3. At each water coil, circuit balance valve.

END OF SECTION 22 05 23

SECTION 22 07 00 - PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and Install:
 - 1. Piping insulation
 - 2. Jackets and accessories

1.2 RELATED DOCUMENTS:

- A. The General Provisions of the Contract, including General and Special Conditions and the General Requirements apply to the work specified in this section.
- B. Insulation furnished under this specification shall comply with all requirements of the State Energy Code and the recommendations of the latest edition of ASHRAE 90.1 and these specifications. The more stringent of these shall be the standard for the work provided under these specifications.
- C. The work included under this specification consists of furnishing all labor, accessories, equipment, and materials necessary for installation of all piping, and mechanical equipment insulation systems. This includes but is not limited to:
 - 1. Thermal Insulation
 - a) Domestic hot water piping
 - b) Heating water piping
 - c) Chilled water piping
 - d) Refrigerant piping
 - 2. Condensation Prevention Insulation
 - a) Domestic cold-water piping
 - b) Cooling coil condensate piping

1.3 RELATED WORK IN OTHER SECTIONS

220000 PLUMBING INDEX
220500 GENERAL PLUMBING REQUIREMENTS
230500 GENERAL HEATING, VENTILATING AND AIR CONDITIONING
REQUIREMENTS

1.4 REFERENCES

- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of Guarded Hot Plate Apparatus.
- C. ASTM C195 - Mineral Fiber Thermal Insulation Cement.

- D. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- E. ASTM C518 - Test Methods for Steady-State Heat Flux, Heat Flow Meter Apparatus.
- F. ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- G. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- H. All preformed Fiberglass pipe insulation with factory applied jackets shall meet the following standards:

ASTM E84 - Surface Burning Characteristics of Building Materials

ASTM E96 – Jacket Permeance

ASTM C335-Steady-State Heat Transfer Properties of Horizontal Pipe Insulation

ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

ASTM C547 - Mineral Fiber Preformed Pipe Insulation

ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

ASTM C795 – Thermal Insulation for use in Contact with Austenitic Stainless Steel

ASTM C1136 – Flexible Low Permeance Vapor Retarders for Thermal Insulation: Types I-IV.

NRC 1.36 – Nuclear Regulatory Commission Guide 1.36 Non-Metallic Thermal Insulation

NFPA 90A

NFPA 255

UL 723 – Composite Surface Burning Characteristic

CAN ULC S102-M

MIL – I – 22344D – Insulation, Pipe, Thermal, Fibrous Glass

MIL – I – 24244C (Ships)

USCG 164.109 – Non-Combustible Materials

New York City MEA

GreenGuard Certified for Indoor Air Quality

GreenGuard Certified for Children and Schools

1.5 DEFINITIONS

- A. Exposed Location: Exposed in mechanical rooms, rooms with finished walls or ceilings, and pipe chase between toilet rooms and equipment rooms.
- B. Concealed Location: Located in furred spaces, attics, crawl spaces, above suspended ceilings in finished or unfinished rooms, or all other locations not exposed to view.
- C. Cold Piping: Shall include domestic water and other piping with surface temperatures less than 70°F.

- D. Hot Piping: Domestic hot water, supply and return and other piping with surface temperatures greater than 105°F.
- E. Exterior Locations: All locations exposed, unexposed above grade or below grade beyond the building floor, wall or roof line of the structure or building
- F. Location and Insulation Requirements:
 - 1. Cold Water, including Non-potable Water (NPW): Insulate as follows:
 - a) All piping above ceilings and in walls.
 - b) Entire system except for stubouts to fixtures.
 - 2. Domestic Hot: Insulate as follows:
 - a) Entire system except for stubouts to fixtures.
 - 3. Chilled Water Supply and Return and Heating Water Supply and Return:
 - a) All piping above ceilings, drops in wall and in mechanical rooms.
 - 4. K Factors: All K Factors shown in this Specification are expressed in BTU-in/hr.-ft²-F.

1.6 SUBMITTALS

- A. Comply with Section 220500.
- B. Product Data: Provide product description, list of materials and thickness for each service and location.
- C. Manufacturer's Installation Instructions: Indicate procedures, which ensures acceptable workmanship and installation standards will be achieved.

1.7 QUALITY ASSURANCE

- A. Qualifications of Applicator: Company specializing in piping insulation application with five (5) years minimum experience.
- B. Regulatory Requirements Fire Hazard Classification: Insulation shall have a composite (insulation, jacket or facing, and adhesive to secure jacket or facing) fire hazard rating as tested by ASTM E-84, NFPA 255, and UL 723 not to exceed 25 flame spread, 50 fuel contribution, and 50 smoke developed. Materials shall be labeled accordingly.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Compliance: Comply with Section 230500. Deliver materials to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness and store in a warm, dry location.

1.9 PROJECT/SITE CONDITIONS

- A. Storage Environment: Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation while in storage.

- B. Environmental Requirements: Perform work at ambient and equipment temperatures as recommended by the insulation manufacturer.
- C. Protection: Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Repair or replace any such insulation or covering damaged prior to final acceptance of work.
- D. Application Surfaces: Surface shall be dry, free of dust, oil, construction residues or other foreign materials before insulation is applied. Piping joints shall be dry, leak free and tested before application of insulation occurs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Owens-Corning
 - 2. Knauf
 - 3. Johns Manville
 - 4. Industrial Insulation Group

2.2 MATERIALS

- A. Glass Fiber:
 - 1. Insulation: ASTM C547; rigid molded, noncombustible.
 - a) 'K' value: ASTM C335, 0.24 at 75 °F
 - 1) K values shall conform to the following at 75°F
 - (a) Heating water to 250°F: .28
 - (b) Heater water to 350°F or above: .32
 - (c) Chilled water 40°F to 55°F: .24
 - (d) Domestic water 105°F or greater: .24
 - b) Minimum Service Temperature: -20°F
 - c) Maximum Service Temperature: +450°F
 - d) Maximum Moisture Absorption: 0.2 percent by volume
 - 2. Vapor Barrier Jacket:
 - a) All Service Vapor Retarder Jacket
 - b) Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
 - c) Secure with self sealing longitudinal laps and butt strips.
 - d) Alternate: Paper Free All Service Vapor Retarder Jacket

2.3 JACKETS

- A. A.PVC Plastic
 - 1. Jacket: ASTM C921, one-piece molded type fitting covers and sheet material, off white color.
 - a) Minimum Service Temperature: -40°F

- b) Maximum Service Temperature: +150°F
 - c) Moisture Vapor Transmission: ASTM E96; 0.002 percent by volume
 - d) Maximum Flame Spread: ASTM E84: 25.
 - e) Maximum Smoke Developed: ASTM E84; 50
 - f) Thickness: 20 mil.
 - g) Connections: Brush on welding adhesive
 2. Covering Adhesive Mastic: Compatible with insulation
 3. Acceptable Manufacturers
 - a) Proto
 - b) Zeston
 - c) Speedline
- B. Canvas Jacket; UL listed.
1. Fabric: ASTM C921, 6 oz/sq yd, plain weave cotton treated with dilute fire-retardant lagging adhesive.
 2. Lagging Adhesive: Compatible with insulation.
 3. Aluminum Jacket: ASTM B209.
 - a) Thickness: 20 mil inch sheet.
 - b) Finish: Smooth.
 - c) Joining: Longitudinal slip joints with 2-inch laps.
 - d) Fittings: 0.016-inch-thick die shaped covers with factory attached protective liners.
 - e) Metal Jacket Bands: 3/8 inch wide; 0.015-inch-thick aluminum.
- C. Aluminum Jacket: ASTM B209
1. Thickness: 0.016-inch sheet.
 2. Finish: Smooth
 3. Joining: Longitudinal slip joints and 2-inch laps.
 4. Fittings: 0.016-inch-thick die shaped fitting covers with factory attached protective liner.
 5. Metal Jacket Bands: 3/8 inch wide; 0.015-inch-thick aluminum.
- D. Stainless Steel Jacket: Type 304 stainless steel.
1. Thickness: 0.016 inch
 2. Finish: Smooth
 3. Metal Jacket Bands: 3/8 inch wide; 0.016-inch-thick stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect work in conformance with Section 220500.

3.2 PREPARATION

- A. Pipe Testing: Testing of piping shall be completed, and leaks repaired prior to application of insulation. Surfaces shall be clean and dry before proceeding.
- B. Installation: Install materials after piping has been tested and approved. See Section 220500.
- C. Surface Cleaning: Clean surfaces for adhesives.

3.3 INSTALLATION

- A. Pipe Insulation:
 - 1. Manufacturer's Instructions: Install materials according to manufacturer's instructions.
 - 2. Finished Surface Temperature: Insulation thickness shall conform to those recommended ASHRAE 90.1, latest edition, unless otherwise specified. Thickness of insulation shall be sufficient to keep surface temperatures below 115°F.
 - 3. Continuity: Apply insulation tightly over clean, dry surfaces with sections or edges firmly butted together. Make insulation continuous through sleeves or openings in walls and floors.
 - 4. Make insulation continuous at pipe hangers, trapezes, and other types of supports. Do not notch insulation to fit over hangers, trapezes, and other supports. Install shields at all supports.
 - 5. Name Plates: Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
 - 6. Supports: Finish insulation neatly at hangers, supports and other protrusions. Locate insulation or cover seams in least visible locations.
 - 7. Inserts: Provide an insert, not less than 6-inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2-inches diameter or larger, to prevent insulation from compressing at support points. Inserts shall be cork, hardwood or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used with field fabricated insulation value equal to insulation approved by the Project Engineer. Do not use calcium silicate inserts or other material that can absorb moisture on any below ambient piping system.
 - 8. Enclosures: Do not insulate hot water heating pipe within radiation enclosures.
 - 9. Flanges: On insulated piping without vapor barrier and piping conveying fluids 140°F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.
 - 10. Equipment Fittings and Valve Coverings: Insulate all equipment, fittings and valves. Terminate insulation neatly with insulating and finishing cement troweled on bevel.
 - 11. Preformed Fittings Locations: All fittings and valves shall be insulated with preformed fiberglass for fittings, mitered sections of pipe insulation or fiberglass blanket insulation of equal thickness to the adjacent pipe insulation. Cover the

- fittings, valves and insulation with preformed PVC jacket. Close jacket with stainless steel tacks and compatible adhesive.
12. Radiation Barrier: When insulating hot pipe fittings, a layer of kitchen-type aluminum foil shall be applied over the first fiber glass insert applied, making sure the aluminum foil is extended over the adjacent pipe insulation. A second fiber glass insert shall then be applied over the foil with a vapor seal at all the aluminum foil edges. Insulation thickness shall be such that the surface temperature shall not exceed 115°F.
 13. Expansion Devices: On insulated piping with vapor barrier; insulate all equipment, fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
 14. Fasteners: Avoid the use of staples on vapor barrier jackets. Seal vapor barrier penetrations with white vapor barrier finish and adhesive.
 15. Adhesive Limitations: Apply adhesives to not exceed the coverage recommended by the manufacturer.
 16. Wall, Floor and Ceiling Penetrations: Continue insulation with vapor barrier through penetrations including walls, floors and ceilings.
 17. Enclosure: All insulation ends shall be firmly butted and secured with minimum 3-inch-wide butt strips. Exposed end of pipe insulation shall be sealed with vapor barrier mastic.
 18. Repairs: Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.
 19. Service Access: When equipment with insulation requires periodical opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.
 20. Unless pre-insulated pipe is used, all insulation below grade shall be polyurethane spray foam covering suitable for use in wet environments without degradation. Piping shall be supported by a rigid Styrofoam board 4-inch thick which exceeds the width of the pipes laid in the trench parallel to the pipe. All pipes shall be wrapped with two wraps of 1 1/2-inch-thick fiberglass blanket before spraying. Spray foam shall be applied to assure a 2-inch MINIMUM coverage. Insulation shall be coated with Deer-O Foam Cap W-256 applied at the rate of one gallon per 100 square ft. or vapor barrier protection with a perm rating of 0.0019.
 21. A complete moisture and vapor seal shall be provided on cold surfaces where vapor barrier jackets or coatings are required. Anchors, hangers, and other projections shall be insulated, and vapor sealed to prevent condensation. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
 22. Insulation shall be installed in a workmanlike manner by workmen regularly engaged in this type of work. Insulation shall not be applied until all surfaces are clean and dry and until inspection and release for insulation application.
 - a) Do not notch insulation to fit around trapezes or wall-mounts fabricated from slotted metal framing (“unistrut or equal”), angle iron or other materials. Insulation shall be continuous across the support and an

insulation shield shall be installed to prevent crushing the insulation.
Pipe clamps shall be sized to fit around insulation and shield.

- b) Insulation may be notched or trimmed around riser clamps. Seal exposed insulation.

B. Jackets:

1. Indoor, Concealed Applications: Insulated pipes conveying fluids above ambient temperature shall have standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish fittings, joints, and valves with pre-molded PVC jackets secured with stainless steel tacks. The precut insulation shall be held in place by copper wire or hemp twine and be removable without damage to the insulation or jacket. Leave surfaces clean and ready for painting.
2. Indoor, Concealed Applications: Insulated dual-temperature pipes or pipes conveying fluids below ambient temperature shall have vapor barrier jackets, factory-applied or field-applied. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe, and finish with pre-molded PVC jackets.
3. Indoor, Exposed Applications: Mechanical Equipment Rooms, all insulated piping to be finished with aluminum jacket secured with metal jacket bands.
4. Indoor, Exposed Applications: Same as Indoor, Concealed Applications except that in addition the insulation shall be covered with an aluminum jacket secured with metal jacket bands.
5. Exterior Applications: Same as Indoor, Exposed Applications plus connect with a modified S lock equal to Premetco "Loc-Jack" Z-Crimp, Factory or Field installed. All seams shall be sealed with silicone caulking and have seams oriented so that the jacketing will shed water & not tend to trap and enter rainwater.

3.4 APPLICATION

A. Fittings and Valves Insulation:

1. Pre-molded Fittings: All insulated pipe fittings shall be insulated with 20 mil PVC Zeston one-piece pre-molded insulated fittings wherever possible. If Zeston fittings are not available for the use required, comply with the following paragraph #2. Insulate fittings with fiberglass tightly wrapped with copper wire or heavy hemp twine to within 1/4 inch of thickness of adjoining copper wire or insulation, finished with 1/4 inch of insulating cement troweled flush with pipe insulation. A tack coat of mastic vapor barrier Foster 60-25 or 26-to-1/16-inch thickness or equal shall be applied to fittings and valves. Apply 6 oz. fiberglass canvas jacket to build-up (not PVC) fitting band valve insulation. Cement laps thoroughly with Foster 81-42 or 30-36 adhesive.

B. Perm Rating Vapor Barrier Mastic Coatings:

1. Perm rating not more than 0.25 when tested in accordance with ASTM E-96, Procedure A Fire Retardant.

C. Adhesives, Sealers, Facings, and Vapor Barrier Coatings:

1. Compatible with materials to which applied, and shall not corrode, soften, or otherwise attach the pipe or insulation materials in either the wet or dry state. Use only adhesives, sealers, facings, and vapor barrier coatings recommended by the approved manufacturers of insulation materials.

3.5 SCHEDULE

<u>Service</u>	<u>Pipe Size</u>	<u>Thickness</u>
CW, HW, HWC	All sizes CW, 1/2 inch to 2-inch HW, HWC	1 inch
	2-1/2 inch and Larger HW, HWC	1-1/2 inch
NPW & Cooling Condensate	All sizes	1 inch
HWS, HWR CHWS, & CHWR	All sizes	2 inches

END OF SECTION 22 07 00

SECTION 22 10 00 - PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 SCOPE

- A. This section of the specifications encompasses the basic materials and methods of the various piping systems covered in Division 25.
- B. Standards: The latest edition of each standard referenced shall be used to determine compliance.

1.3 RELATED WORK IN OTHER SECTIONS

220000 PLUMBING INDEX
220500 GENERAL PLUMBING REQUIREMENTS
220523 VALVES
220700 PIPING INSULATION
230519 PIPING SPECIALTIES
230548 VIBRATION ISOLATION AND EXPANSION COMPENSATION
232113 HYDRONIC PIPING SYSTEMS

1.4 IDENTIFICATION OF PIPING

- A. All accessible piping shall be labeled at not more than 10 ft. intervals with labels indicating the service and direction of flow. Pipe labels shall be self-adhesive labels, all-temperature Perma-Code pipe markers No. B-500, manufactured by the W.H. Brady Company. The background color code for all markers shall conform to the American National Standard A13.1 - 1975 "Scheme for the Identification of Piping Systems."
- B. The color red shall be for the exclusive use on fire protection service piping and sprinkler piping per OSHA regulations (CFR 1910.144).

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS

- A. Domestic water system
 - 1. Above grade:
 - a) Copper: Shall be Type K soft drawn, or Type L hard drawn, seamless copper tubing conforming to ASTM B88, with wrought copper and bronze solder joint pressure fittings conforming to ANSI B16.22.
 - 2. Underground:

- a) Copper: Type K hard, seamless copper tubing conforming to ASTM B-88 with silver brazed joints (ASTM B-260 Class BA9-1) with wrought copper fittings per ANSI B16.22.
- B. Soil and waste system
1. Above ground:
 - a) Cast Iron: Shall be cast iron hub and spigot soil pipe or hubless cast iron pipe and fittings, (No-Hub Couplings shall conform to CISPI Standard 310 & ASTM A-1277 or latest edition) conforming to ASTM A74 (latest edition) and/or Cast-Iron Soil Pipe Institute (CISPI) CS-888 and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. The hub and spigot pipe shall use compression gasket joints per ASTM C-564 & ASTM 1563.
 2. Underground inside building:
 - a) Cast Iron: Shall be cast iron hub and spigot soil pipe or hubless cast iron pipe and fittings, (No-Hub Couplings shall conform to CISPI Standard 310 & ASTM A-1277 or latest edition) conforming to ASTM A74 (latest edition) and/or Cast-Iron Soil Pipe Institute (CISPI) CS-888 and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. The hub and spigot pipe shall use compression gasket joints per ASTM C-564 & ASTM 1563.
- C. Sanitary vent system
1. Vent piping 2" and smaller in diameter may be schedule 40 galvanized steel pipe conforming to ASTM A-53 with 150 pound galvanized malleable iron screwed fittings conforming with ANSI B16.3. Vent piping larger than 2" shall be cast iron as specified for interior soil and waste.
- D. Refrigeration piping system
1. COPPER: Shall be "ACR" Type L hard drawn, seamless copper tubing conforming to ASTM B280, with wrought copper and bronze solder joint pressure fittings conforming to ANSI B16.22.
- E. Heating water and chilled water and condenser water systems
1. Copper: Shall be Type K soft drawn, or Type L hard drawn, seamless copper tubing conforming to ASTM B88, with wrought copper and bronze solder joint pressure fittings conforming to ANSI B16.22.
 2. Black steel: Shall be Schedule 40, black steel pipe conforming to ASTM A-53. Fittings 2" and smaller shall be 250-pound malleable iron screwed fittings conforming with ANSI A-197. Fittings 2 1/2" and larger shall be scheduled 40 weld fittings per ASTM A-234. Flanges shall be 150-pound slip-on or wild neck types, flat faced, per ASTM A181, Grade 1.

F. Natural gas piping system

1. Black steel: Above grade piping shall be Schedule 40, black steel pipe conforming to ASTM A-53, with 150-pound malleable iron screwed fittings conforming with ANSI B16.3. or seamless carbon steel weld fittings conform to ASTM A-234.
2. Underground piping shall be schedule 40 black steel pipe conforming to ASTM A-53 machine wrapped with Scotchwrap PVC tape using 50% overlap. Fittings and joints shall be double wrapped to a minimum 6 inches beyond the fitting. Pipe shall be primed prior to wrapping per manufacturer's recommendations.

G. Steam piping

1. Black steel: Shall be Schedule 40, black steel pipe conforming to ASTM A-53 or A-53, with welded steel fittings 2" and larger. Piping 1 1/2" and smaller shall have 150-pound malleable iron screwed fittings conforming with ANSI B16.3.

H. Steam condensate piping

1. Black steel: Shall be Schedule 80, black steel pipe conforming to ASTM A-53 or A-53, with welded steel fittings 2" and larger. Piping 1 1/2" and smaller shall have 150-pound malleable iron screwed fittings conforming with ANSI B16.3.

I. Preinsulated piping systems

1. Preinsulated system may be utilized for chilled water only with approval of Engineer. Submit for prior approval prior to bidding.
2. Chilled water: The pre-insulated piping system shall consist of a Schedule-40 polyvinyl-chloride-plastic pipe that meets the requirements of National Sanitation Foundation Standard No. 14, a sealed PVC-plastic jacket with polyurethane-foam insulation completely filling the annular space between the pipe and the jacket. Joints shall be made using bell-and-spigot type joints utilizing a gasket ring. Jacket ends shall be sealed with factory installed watertight end seals. Piping shall be equal to Chill-Guard as manufactured by Ric-Wil. All joints shall be insulated and sealed with factory supplied units.

2.2 JOINTS

A. Copper:

1. Silver brazed joints shall use brazing material containing approximately 45% silver, 15% zinc, 25% cadmium and 15% copper. Joints shall conform to ASTM B-260 Class BAg-1. Approved materials include Mueller #122, Handy and Harmon "Easy Flo45" and United Wire and Supply "Sil-Bond 45".

B. Cast Iron:

1. Neoprene Rubber gaskets for hub and spigot piping per ASTM C564.
2. No hub joints shall consist of couplings that conform to CISPI 301.

- C. Black Steel:
 - 1. Screwed joints shall be made with no more than three threads showing using teflon tape or teflon joint sealing compound.
 - 2. Welded joints shall be fusion welded to full metal depth with width at least 2 1/2 times the depth of the metal being joined.
- D. Bell and spigot joints shall conform to AWWA C200 with rubber gaskets.
- E. Bonded joints shall have metallic bond including joints made with flexible couplings, caulking or rubber gaskets. Metallic bond shall be of ferrous material to effect continuous conductivity. Bond wire shall be type RHW-USE, size 1/0 neoprene gasketed copper conductor. Bond shall be thermal weld type.
- F. Insulating joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe. Insulating joints shall consist of a sandwich type flange insulating gasket of the dielectric type, insulating washers and insulating sleeves for flange bolts. Gaskets shall be full faced. Bolt insulating sleeves shall be full length. Units shall be of a construction to prevent metal to metal contact of dissimilar piping materials.

2.3 FLOOR, WALL, AND CEILING PLATES

- A. Where exposed pipes pass through finished floors, finished walls, or finished ceilings, they shall be fitted with chromium plated spun brass flanges or flanges to match the type of pipe or pipe finish used. Plates shall be large enough to completely close the hole around the pipe and shall be not less than 1-1/2" or more than 2-1/2" larger than the diameter of the pipes. All plates shall be securely held in place.

2.4 UNIONS

- A. Piping 2-1/2" and larger to have bolted flange unions with gaskets of material suitable for the specified service. Ground joint unions with brass to iron seats shall be used in piping 2" and smaller. Unions shall be installed at all valves and equipment connections.
- B. Insulating Unions: See Specification Section 230519.

2.5 HANGERS AND ANCHORS

- A. To prevent galvanic action between copper pipe and a dissimilar metal, copper pipe shall be isolated to prevent the pipe from contacting the dissimilar metal. This may be accomplished by mounting the pipe in an isolation fitting, or by wrapping the pipe with a 20-mil thickness of UPC-rated isolation tape. The 20-mil thickness can be accomplished by using a single wrap of 20-mil tape or by using 10-mil tape with a 50% overlap.
- B. Copper pipe does not need to be isolated from copper plated pipe hangers that are suspended from hanger rods.
- C. Copper pipe mounted on slotted metal framing ("unistrut or equal"), angle iron, or other dissimilar metal support shall be isolated as described above, even if pipe clamps used

are copper plated. Painted, epoxy or powder-coated finishes on the metal support are not an acceptable means of isolation.

- D. All piping shall be rigidly supported from the building structure by means of adjustable ring type hangers. Where pipes run side by side, support on rod and angle trapeze hangers. Hangers shall be spaced not greater than 5 feet on centers for cast iron piping, 6 feet on centers for copper piping and 10 feet on centers for steel piping. Plastic pipe shall be supported on not more than 3 feet centers. Round rods supporting the pipe hangers shall be of the following dimensions:

1.	1/2 inch to 2-inch pipe	3/8-inch rod
2.	2-1/2" inch to 3-inch pipe	1/2-inch rod
3.	4-inch to 5-inch pipe	5/8-inch rod
4.	6-inch pipe	3/4-inch rod
5.	8-inch pipe	7/8-inch rod

- E. Rods for trapeze hangers shall be a minimum of 3/4 inch and shall have the equivalent cross section listed above per pipe supported. The use of pipe hoods, chains, or perforated iron for pipe supports will not be permitted. Insulated piping shall have hangers outside of insulation with 18 ga. protection sleeves 12" long. Anchors and guides shall be as detailed on the drawings. The Contractor shall provide inserts in the building construction at the time the concrete is poured, and the hangers shall be attached to these inserts. Where inserts cannot be used expansion shields may be used provided the hanger is not attached rigidly to the bolt but is supported from an angle held in place by the expansion bolt. The use of expansion shields must be approved by the Architect/Engineer. See drawings and details for support of tunnel piping.
- F. Hanger rods for all equipment, pipes, ducts, trapezes, vibration isolators, etc., shall be installed straight, true, and plumb. Do not bend or flex hanger rods to accommodate sloping structures, avoid obstacles, or for any other purpose. Where necessary, utilize swivel beam clamps, beveled or swivel hardware, angled, swivel or hinged brackets spanning members or other appropriate means of connection.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide and erect in a workmanlike manner according to the best practices of the trade all piping shown on drawings and required for the complete installation of the systems. The piping shown on the drawings shall be considered as diagrammatic for clarity in indicating the general run and connections and may or may not in all parts be shown in its true position. The piping may have to be offset, lowered, or raised as required or as directed at the site. This does not relieve the Contractor from responsibility for the proper erection of systems or piping in every respect suitable for the work intended as described in the specifications and approved by the Architect/Engineer.
- B. In the erection of all piping, it shall be properly supported, and proper provisions shall be made for expansion, contraction, and anchoring of piping. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing or forcing, properly clearing equipment and all

windows, door, and other openings. Cutting or other weakening of the building structure to facilitate installation will not be permitted. All pipes shall have burrs and/or cutting slag removed by reaming or other cleaning methods. All changes in direction shall be made with fittings.

C. Preinsulated Piping Systems

1. All piping adjoining this system shall be anchored at or near the point of connection to avoid imposing any external forces on the carrier pipe. The Contractor shall pour concrete anchor blocks at every change of direction after testing the pipe. The anchor blocks are to be sized in accordance with forces resulting from thermal stress, existing soil conditions, and shall be in accordance with the manufacturer's recommendations.
2. Immediately after the system is installed in the ditch, a partial backfill of selected earth shall be made in the middle of each unit, leaving the joints exposed for inspection of the hydrostatic test. A hydrostatic test of 200-psig shall be required for a period of four hours. No leakage shall be allowed.
3. After hydrostatic testing, final backfill of selected earth shall be hand placed and hand tamped to 12" minimum over the top of the jacket. Remainder of the backfill shall be free of large boulders, rocks over 6" in diameter, frozen earth, or foreign matter. The backfill operation shall now be completed by any convenient means. Do not use wheeled or tracked vehicles for tamping.
4. The services of a factory-trained Field Service Instructor shall be required, and materials shall be stored, handled, and installed in accordance with Manufacturer's recommendations. The Field Service Instructor shall be present during critical stages of the installation and testing.

D. All open ends of pipes and equipment shall be properly capped or plugged with plugs manufactured for this purpose to keep dirt and other foreign materials out of the system. Plugs of rags, wool, cotton waste or similar materials may not be used in plugging.

E. All piping shall be arranged avoiding interference with removal and maintenance of equipment, filters, or devices; and not blocking access to manholes, access openings, etc. Flanges or unions as applicable for the type of piping specified shall be provided at the piping connections to all items of equipment.

F. Valves and specialties shall be placed to permit easy operation and access, and valves shall be regulated, packed, and adjusted at the completion of the work before final acceptance.

G. All piping shall be erected to insure proper draining. Steam mains shall be pitched down in the direction of flow, a minimum of one inch per 40 feet or appropriately trapped. Where steam and condensate flow in opposite directions within the same pipe, the pipe shall be 2 sizes larger than shown unless specifically shown on the drawings that counterflow of condensate was intended by the design. Condensate return mains shall be pitched down in the direction of flow, one inch per 20 feet. Domestic water piping may be run level but shall be free from traps.

H. Soil and waste piping and other gravity drains shall be sloped down in direction of flow minimum one inch in 20 feet.

3.2 ACCESS DOORS

- A. Furnish all access doors required for access to valves, controls, or other items for which access is required for either operation or servicing. All costs incurred through failure to perform this function as the proper sequence of the work dictates shall be borne by this Mechanical Contractor.
- B. The type of access door shall be as required by the room finish schedule. Acoustical tile access doors shall be equal to Krueger Style B, Style A for acoustical plaster, or Style C-CF for sidewall drywall or plaster construction.

3.3 JOINTS

- A. Resilient molded gaskets shall be used on hub and spigot piping. For cast iron soil pipe not located under buildings, the Contractor may also use the No-hub sanitary system for pipe 6" and below with neoprene sealing gaskets, stainless steel retaining sleeves and two draw bands. An adequate torque wrench shall be used for system installation in accordance with manufacturer's recommendations.
- B. Screwed Joints: Screwed joints shall be American Standard taper pipe threads. Ream pipe ends and remove burrs after threading. Make up joints using an approved compound or teflon tape, applied to the male threads only.
- C. Brazed and Soldered Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool before sweating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections.
- D. Welded Joints: On black steel piping 2 inches and above in size, the joints shall be welded. Welding shall be done using either gas or electric welding equipment. Certified welders shall be used. All pipe surfaces shall be thoroughly cleaned before welding. Each joint shall be beveled before being welded. Piping shall be securely aligned and spaced, and the width of circumferential welds shall form a gradual increase in thickness from the outside surface to the center of the weld. The Contractor shall use appropriate materials to protect the structure and provide adequate fire protection at all locations where welding is done. All elbows shall be long radius unless otherwise specified. Wherever tee connections are made to piping systems on the main run, welding sockets may be installed for the branch connections up to one half the size of the main run. On connections larger than one half the size of the main run, welding tees shall be used. The use of fittings formed from welded pipe sections will not be permitted.
- E. Flanged Joints:
 - 1. Cast iron flanges shall conform to the American Standard for cast iron pipe flanged fittings, Class 125 (B.16.1). Gaskets shall be suitable for the service on which used.
 - 2. Steel flanges shall be 150 lb. raised face type.

F. Solvent Welded Joints:

1. Pipe shall be cut square with pipe cutters designed specifically for plastic pipe. Pipe shall be protected from serrated holding devices and abrasion. Remove burrs from inside and outside of pipe. Clean the joining surfaces using an approved Cleaning compound. Following the instructions on the can, apply the cement and assemble the joint as quickly as possible before the cement dries.

3.4 PUMP AND EQUIPMENT CONNECTIONS

- A. All piping connecting to pumps or other equipment shall be installed with isolation valves and flexible connections to prevent strain at the connection to equipment. The Contractor shall be required as directed to disconnect piping to demonstrate that piping has been so connected. Provide a suction diffuser at each end suction pump where the inlet piping has a straight run of less than 15 pipe diameters in length. Suction diffusers shall consist of angle type body with inlet vanes and combination diffuser-strainer-orifice cylinder with 3/16-inch diameter openings for pump protection. Strainer free area shall be five times the section area of the pump connection. Provide an adjustable support foot for diffusers installed on end suction pumps.

3.5 PIPE SLEEVES

- A. Pipe sleeves shall be furnished and set by the Contractor, and the Contractor shall be responsible for their proper and permanent location. Piping will not be permitted to pass through footings, beams or ribs unless so noted on the drawings or with the consent of the Architect/Engineer. Pipe sleeves shall be installed and properly secured in place at all points where pipes pass through concrete or masonry construction and through all exterior walls, regardless of construction. Pipe sleeves, except sleeves in footings and beams shall be of sufficient diameter to provide approximately 1/4-inch clearance around the pipe, and in cases of insulated pipes, approximately 1/4-inch around the insulation. Pipe sleeves in footings and beams and exterior walls shall be of steel pipe. Sleeves in footings shall be not less than one inch or more than two inches larger in diameter than the pipe to be installed. Pipe sleeves in floors shall be cut flush with finished floor. Openings between piping and sleeves shall be made watertight with plastic cement to a minimum depth of two inches. Openings between piping and sleeves in all masonry or concrete interior walls and partitions shall be similarly caulked for acoustical reasons.

3.6 EXPANSION AND CONTRACTION

- A. The Contractor shall make all necessary provisions for expansion and contraction of piping with offsets or loops and anchors to prevent undue strain.

3.7 PROTECTIVE COATINGS

- A. All underground pipe except exterior cast iron water distribution pipe shall be wrapped with "Scotchwrap" No. 50 tape to give not less than two complete layers on the entire underground piping system, or piping shall have X-TRU Coat factory applied plastic protective covering.

3.8 TESTING

- A. Before any insulation is installed or before piping is covered or enclosed all piping systems shall be tested and proved tight at not less than 1 1/2 times the maximum service pressure which the piping systems will be required to handle, unless otherwise specified.
- B. All tests shall be conducted in the presence of the Architect/Engineer and the building Owner or his representative. Any systems failing to meet the specified test requirements shall be corrected and retested until the test requirements are met.

3.9 FLUSHING, DRAINING AND CLEANING PIPE SYSTEMS

- A. The Contractor shall flush water piping systems with water before placing them in operation. After systems are in operation and during the test period all strainer screens shall be removed and thoroughly cleaned. The Contractor shall notify the Architect/Engineer in writing when this requirement is to be accomplished.
- B. All domestic water lines shall be sterilized as described in Section 221113 -DOMESTIC WATER SYSTEM of these specifications.

END OF SECTION 22 10 00

SECTION 23 00 00 - HEATING, VENTILATING, AND AIR CONDITIONING INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Heating, Ventilating, And Air Conditioning Work, as indicated on the Drawings and specified herein. Heating, Ventilating, And Air Conditioning work indicated on the Drawings and/or specifications covering other trades shall conform to Division 23 of these Specifications.
- B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Heating, Ventilating, And Air Conditioning systems, shall be accomplished without additional cost to the Owner.
- C. Furnish all labor and materials required for Heating, Ventilating, and Air Conditioning service connections to all the various items of equipment requiring connection throughout the project shown on the Contract Drawings (even if not shown on Heating, Ventilating, and Air Conditioning Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 HEATING, VENTILATING AND AIR CONDITIONING DIVISION INDEX

230100 DEMONSTRATION AND TRAINING
230500 GENERAL HEATING, VENTILATING, AND AIR CONDITIONING
REQUIREMENTS
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230519 PIPING SPECIALTIES
230548 VIBRATION ISOLATION AND EXPANSION COMPENSATION
230593 BALANCING OF MECHANICAL SYSTEMS
230713 DUCT INSULATION
232113 HYDRONIC PIPING SYSTEMS
232500 WATER TREATMENT SYSTEMS
233000 AIR DISTRIBUTION
236200 AIR-COOLED CHILLER

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 23 00 00

SECTION 23 01 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. After completion of the installation and upon completion of the Test and Balancing, the Contractor shall schedule the System Demonstration, Operating Test, and Training Session for the Owner.
- B. The following individuals, companies or representatives thereof shall be in attendance.
 - 1. Mechanical Trade
 - 2. Electrical Trade
 - 3. Sheet Metal Trade
 - 4. Controls Trade
 - 5. Test and Balance Agency
 - 6. Air Handler Manufacturer
 - 7. Fan Coil Manufacturer
 - 8. Pump Manufacturer
 - 9. Chiller Manufacturer
 - 10. Boiler Manufacturer

1.3 RELATED WORK IN OTHER SECTIONS

230000 HEATING, VENTILATING AND AIR CONDITIONING INDEX
230500 GENERAL HEATING, VENTILATING, AND AIR CONDITIONING
REQUIREMENTS
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230548 BALANCING MECHANICAL SYSTEMS

1.4 QUALIFICATIONS

- A. The representatives listed in 1.2B above shall be thoroughly familiar with the operation and function of the equipment or systems he represents and be prepared to indoctrinate the Owner or his designated personnel.

PART 2 - PRODUCTS

2.1 SCHEDULE

- A. The Contractor shall schedule and coordinate the System Demonstration and Training Session for the Owner over 1 consecutive 8 hour working day.
- B. The Owner may, after the training session has started:

1. Excuse the equipment manufacturer when his indoctrination session is completed.
2. Conclude the session early if he feels the intent and purpose of the session has been met.

2.2 ADJUSTMENTS

- A. The Contractor shall have available, tools, equipment, and personnel to readjust or refine the operation of any part of the mechanical system as directed by the Owner or Architect/Engineer.

PART 3 - EXECUTION

3.1 TRAINING

- A. The Contractor shall schedule and coordinate the indoctrination of the Owner and his designated personnel during the Operating Test. The proposed time schedule shall be coordinated with the individuals, companies or representatives who will be conducting the indoctrination and training. This proposed time schedule shall be submitted to the Architect/Engineer for approval.
- B. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and system at agreed upon times.
- C. For equipment requiring seasonal operation, perform instructions for other seasons within six (6) months.
 1. Contractor shall provide a minimum of eight (8) hours of training for seasonal system operation.
 2. Contractor shall prepare a written report of training and submit to architect upon completion of training.
- D. Use operation and maintenance manuals as a basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- E. Prepare and insert additional data in Operation and Maintenance manual when need for such data become apparent during instruction.

3.2 DOCUMENTATION

- A. The Contractor shall prepare an indoctrination schedule similar to the following:
INDOCTRINATION SCHEDULE:
PROJECT:
LOCATION:

PERSONNEL	ITEM/SYSTEM	DATE	START TIME	STOP TIME

- B. The Owner shall initial each line to verify attendance.

3.3 OPERATING INSTRUCTIONS

- A. The operating instructions specified in Sections 230500 and 253000 of these specifications shall be presented at the start of the Session. These instructions shall include manufacturer's published data having all information that does not apply crossed out.

3.4 OPERATING TEST

- A. The Contractor shall conduct an operational test on all equipment installed under this Division of the Specifications. This test shall be continuous for a minimum of three consecutive days within seven days prior to the demonstration and training period with required data available at the demonstration and shall continue during the demonstration period. The test shall verify the operation of the mechanical systems and demonstrate the performance of the total system.
- B. The following data shall be recorded hourly during normal building occupancy hours.
1. Outdoor ambient temperatures:
 - a) Measure and record outdoor dry bulb and wet bulb temperature.
 - b) Calculate and record relative humidity.
 2. Indoor space temperature:
 - a) Measure dry bulb temperature in several rooms served by each air handling unit including at least one room in each control zone. Note any variation over 2° F from setpoint.
 - b) Measure wet bulb temperature in each space having a space humidistat. Calculate space relative humidity and note any variation over 5% from setpoint.
 3. Water Temperatures:
 - a) Entering and leaving each piece of equipment having a water temperature change including:
 - 1) Boilers
 - 2) Chiller coolers
 - 3) Chiller condensers
 - 4) Air Handling Unit coils
 - 5) Fan Coil Unit coils
 - 6) Unit Ventilator coils
 - 7) Unit Heater coils
 - 8) Base Board Radiation
 - 9) Main branch loops
 - 10) Air washer sumps
 4. Air Temperatures:
 - a) Entering and leaving each piece of equipment having air temperature change including:
 - 1) DX refrigeration coils
 - 2) Chilled water coils
 - 3) Heating water coils
 - 4) Air Handling Unit return, OSA and mixed air
 - 5) Fan coils
 - 6) Unit Ventilator including return, OSA and mixed air

- 7) Unit Heater
- 8) Base Board Radiation
- 5. Air Pressure:
 - a) Building static pressure relative to ambient (outside)
 - b) Supply static pressure at outlet of each air handling unit
 - c) Supply static pressure at the end of each duct run
 - d) Supply static pressure at the inlet of each variable air volume terminal
- 6. Weather Conditions:
 - a) Sun
 - b) Wind velocity
 - c) Precipitation
 - d) Barometric pressure

3.5 READINGS AND MEASUREMENTS

- A. The Test and Balance Agency shall be available and take any or all readings and measurements required or desired by the Owner or Architect/Engineer during this Demonstration and Training Session.

END OF SECTION 23 01 00

SECTION 23 05 00 - GENERAL HEATING, VENTILATING AND AIR CONDITIONING
REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General Mechanical Requirements specifically applicable to Division 23 sections in addition to Division 1- General Requirements.
- B. Scope:
 - 1. The work covered by this division consists of performing all operations in connection with the installation of heating, cooling, ventilating, and plumbing including site utility work as indicated under this section. This entire section applies to all mechanical work and all mechanical sections of these specifications. This Contractor shall read and comply with all sections of these specifications including all General and Special Conditions.

1.2 REFERENCES

- A. Standard Requirements:
 - 1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. All work shall be executed in accordance with the local and state codes, ordinances, and regulations governing the particular class of work involved. This Contractor shall be responsible for the final execution of the work under this heading to suit these requirements. In the event of a conflict between the various codes and standards, the more stringent shall govern. Where these specifications and accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect/Engineer. The Architect/Engineer shall prepare any supplementary drawings required, illustrating how the work may be installed so as to comply. On approval of the change by the Architect/Engineer, the Contractor shall install the work in a satisfactory manner without additional cost to the Owner. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved, and on completion of the work, this Contractor shall obtain and deliver to the Owner final certificates of acceptance. This Contractor shall furnish copies of each certificate to the Architect/Engineer.
- C. The Contractor shall secure all permits and licenses for his work and shall pay all fees in connection with such permits and licenses.
- D. The contractor shall hold and save the Owner free and harmless from liability of any nature or kind arising from his failure to comply with codes and ordinances.
- E. Any and all meter deposits and all utility extension costs shall be paid by the Contractor whose work is done in connection with the service that the meter is connected to.

F. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

1. AABC Associated Air Balance Council
2. ADC Air Diffusion Council
435 North Michigan Ave.
Chicago, IL 60611
3. AGA American Gas Association
1515 Wilson Boulevard
Arlington, VA 22209
4. AMCA Air Movement and Control Association
30 West University Drive
Arlington Heights, IL 60004
5. ANSI American National Standards Institute
1430 Broadway
New York, NY 10018
6. ASHRAE American Society of Heating Refrigerating and Air
Conditioning Engineers
345 East 47th Street
New York, NY 10017
7. ASME American Society of Mechanical Engineers
345 East 45th Street
New York, NY 10017
8. ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103
9. AWWA American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235
10. AWS American Welding Society
2501 NW 7th Street
Miami, FL 33125
11. FM Factory Mutual System
1151 Boston-Providence Turnpike
Norwood, MA 02062
12. FS Federal Specification
General Services Administration
Specifications and Consumer Information Distribution
Section (WFSIS)
Washington Navy Yard, Building 197
Washington, DC 20407
13. NBFU National Board of Fire Underwriters
5530 Wisconsin Avenue, Suite 750
Chevy Chase, Maryland 20815
14. NEC National Electric Code (of NFPA)
15. NEBB National Environmental Balancing Bureau
8224 Old Courthouse Road
Vienna, VA 22180
16. NEMA National Electrical Manufacturer's Association

- 2101 L Street, NW
Washington, DC 20037
17. NFPA National Fire Protection Association
Battery March Park
Quincy, MA 02269
18. NSF National Sanitation Foundation
Box 1468
Ann Arbor, MI 48106
19. OSHA Occupational Safety and Health Administration
U.S. Department of Labor
20. SMACNA Sheet Metal and Air Conditioning Contractor's
National Association
8224 Old Courthouse Road
Vienna, VA 22180
21. TIMA Thermal Insulation Manufacturers Association
Technical Services
1420 King Street
Alexandria, VA 22314
22. UL Underwriters Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062

- G. Underwriters Laboratories Inc. (UL): All materials, appliances, equipment, devices or appurtenances shall conform to the applicable standards of Underwriters Laboratories Inc., where such standards have been established.

1.3 DRAWINGS

- A. Drawings and specifications shall be considered as cooperative, and work or materials called for by one and not mentioned in the other, or vice versa, shall be done and furnished as though treated by both.
- B. In the cases of discrepancies in figures, drawings, or specifications, the Architect/Engineer shall be notified immediately, and his decision shall determine the necessary adjustment. Without such decision, said discrepancies shall not be adjusted by the Contractor save only at his expense, and, in case of any settlement or any complication arising from such adjustment to the Contractor, he shall bear all extra expense involved.
- C. Should it appear that the work intended to be done, or any of the matters relative thereto, are not sufficiently detailed or explained on the drawings or specifications, the Contractor shall apply to the Architect/Engineer for such further drawings or explanations as may be necessary, allowing a reasonable time for the Architect/Engineer to supply same, and the Contractor shall conform to same as part of the Contract.
- D. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, reference shall be made to the Architect/Engineer whose decision shall be final and conclusive. No alleged oral admission, condonation, or inadvertent neglect on the part of the Architect/Engineer will be accepted as an excuse for inferior work.

- E. The mechanical plans do not give exact details as to elevations of ductwork and piping, exact locations, etc., and do not show all offsets, control lines, pilot lines, and other installation details. The Contractor shall carefully lay out his work at the site to conform to the structural conditions, provide proper grading of lines, to avoid all obstructions, to conform to details of installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated, satisfactory operational installation.
- F. Should the particular equipment which any Bidder proposes to install, require other space conditions than those indicated on the drawings, the Bidder shall arrange for such space with the Architect/Engineer before submitting his bid. Should changes become necessary on account of failure to comply with these details, the Contractor shall make such necessary changes at his (the Contractor's own expense).
- G. The Contractor shall submit working scale drawings of all his apparatus and equipment which in any way varies from these specifications and plans which shall be checked by the Architect/Engineer and approved before the work is started, Contractor before work proceeds. Interference with structural conditions shall be corrected by the Contractor.
- H. All equipment shall be installed in accordance with the manufacturer's recommendations. Provide all accessories and components for optimum operation as recommended by the manufacturer.
- I. Site visit: The Contractor shall visit the site prior to bidding and satisfy himself as the conditions under which the mechanical systems are to be installed. No subsequent allowance shall be made in his behalf for failure to make such a visit. Contractor shall examine all work noted under the demolition drawings and all new work and shall satisfy himself as to the extent of work required to be completed.

1.4 SYSTEM DESCRIPTIONS

- A. Not Used.

1.5 PRIOR APPROVALS

- A. Each equipment item for which the Contractor desires to install equipment other than the specific item identified in the equipment schedule or equivalent equipment by manufacturers specifically named in the schedule, the Contractor shall bear full responsibility to prove to the Engineer that the furnished equipment is equivalent to or better than the specified item. Failure to provide such proof will result in rejection of the shop drawing submittal by the Engineer. Prior written or verbal approval by the Engineer of equipment by other manufacturers will not relieve the Contractor of responsibility to provide equivalence. Prior approval is required, however, any prior approval given is intended only to provide preliminary agreement that the alternate manufacturer may make equipment that complies with the specification requirements and not that all equipment manufactured by him is acceptable.

1.6 SHOP DRAWINGS

- A. Shop drawings or fully descriptive catalog data shall be submitted by the Contractor for all items of material and equipment furnished and installed under this Contract. This shall include piping, ductwork, mechanical equipment, plumbing equipment, control items, etc. The Contractor shall submit to the Architect/Engineer a sufficient number of copies of all such shop drawings or catalog data to provide him with as many review copies as he may need, plus three (3) copies for retention by the Architect/Engineer. No materials or equipment shall be installed until officially approved by the Architect/Engineer.
- B. Before submitting Shop Drawings to the Architect/Engineer for review, the Contractor shall examine them and satisfy himself that they are correctly representative of the material or equipment to which they pertain. The Contractor shall so note these Drawings before submitting them. The Contractor's review of Shop Drawings is not intended to take the place in any way of the official review of the Architect/Engineer, and the Shop Drawings which have not been reviewed by the Architect/Engineer shall not be used in fabrication or installing any work.
- C. The review of Shop Drawings or catalog data by the Architect/Engineer shall not relieve the Contractor from responsibility for deviations from the plans and Specifications unless he has, in writing, specifically called attention to such deviations as the time of submission and has obtained the permission of the Architect/Engineer thereon, nor shall it relieve him from the responsibility for error of any kind in Shop Drawings. When the Contractor does call such deviations to the attention of the Architect/Engineer, he shall state in his letter whether or not such deviations involve any extra cost. If this is not mentioned, it will be assumed that no extra costs are involved for making the change.
- D. After receiving approval on the make and type of materials, the Contractor shall order such materials in sufficient time so that no delay or changes will be caused. This is done to facilitate progress on the job and failure on the part of the Contractor shall render him liable to stand the expense of any and all delays occasioned by failure on this part to provide necessary details. All shop drawings shall be delivered to the Architect/Engineer's office within thirty (30) days from the date of the contract.
- E. Shop drawings will be returned unchecked unless the following information is included: reference to all pertinent data in the Specifications or on the drawings, size and characteristics of the equipment, name of the project and a space large enough to accept an approval stamp. The data submitted shall reflect the actual equipment performance under the specified conditions and shall not be a copy of the scheduled data on the drawings.

1.7 SUBMITTALS

- A. Submittal data shall be organized in commercial quality, three ring binders with durable and cleanable covers. Product information for each piece of equipment shall be separated by an indexing leaf with clear tabs. The product name and symbol (i.e. AHU/Air Handling Unit) shall be typed on white paper inserts and placed in appropriate tab. Complete data must be furnished showing performance, quality, and dimensions. A signed review by the Architect/Engineer must be obtained before purchasing any equipment.

- B. The following items shall be submitted for review by the Architect/Engineer but are not limited to:
1. Air Conditioning Units
 2. Fans
 3. Diffusers, Registers and Grilles
 4. Fire Dampers
 5. Pipe Insulation
 6. Duct Insulation
 7. Coils
 8. Temperature Controls
 9. Cross Connection Control Devices
 10. Plenum Materials and Supports
 11. Pumps
 12. Hydronic Air Control Devices
 13. Filter Assemblies and Filters
 14. Fan Coil Units
 15. Flexible Pipe Connections
 16. Heating Terminal Equipment
 17. Roof Top Equipment
 18. Ductwork Shop Drawings
 19. Radiant Heating Equipment
 20. Vibration Isolation Equipment and Calculations

1.8 QUALITY ASSURANCE

- A. General: Comply with Division 1.
- B. Welder Qualifications: Welders shall be certified by the American Society of Mechanical Engineers (ASME) National Certified Pipe for the type of work being performed. Current operators' certificates in accordance with ASME standards shall be on file at the site and shall be available to the Architect/Engineer for examination. Coupons shall be available for review by the Architect and Engineer.
- C. Locations of all pipes, ducts, outlets, appliance, etc., as shown on the drawings, are approximate only and are understood to be subject to such revisions as may prove necessary or desirable at the time the work is installed. Each Contractor will be required to install his work with relation to existing building conditions and shall be entirely responsible for the correctness of his work with reference to finished elevations, etc. Piping shown on the drawings is diagrammatic only and their exact locations, depths, and invert elevations shall be as required for proper flow and coordination with other trades.
- D. The contract drawing depicts graphically the arrangement of piping and ductwork. Should local conditions necessitate a rearrangement, or if any of the piping or ductwork can be installed to better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit three (3) copies of Drawings of the proposed arrangement for the Architect/Engineer's review.
- E. If the Contractor proposes to install equipment, including piping and ductwork, requiring space conditions other than those shown, or to rearrange the equipment, he shall assume

full responsibility for the rearrangement of the space and shall have the Architect/Engineer review the change before proceeding with the work. The request for such change shall be accompanied by Shop Drawings of the space in question.

- F. Each Contractor is responsible for the proper location and size of all slots, holes, or openings in the building structure pertaining to his work, and for the correct location of pipe sleeves.
- G. Each Contractor shall coordinate his work with that of all other trades that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines which require a stated grade for proper operation. Drainage lines shall take precedence over water lines in determination of elevations. In all cases, lines requiring a stated grade for their proper operation shall have precedence over electrical conduit and ductwork.
- H. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Lubricate all equipment properly in accordance with manufacturer's instructions. Furnish zerk grease fittings on all greaseable bearings.
- I. Equipment and Materials: The materials and equipment shall be new and shall be the standard products of the manufacturers regularly engaged in the production of Plumbing, Heating, Cooling, Ventilation, and Fire Protection Equipment, and shall be the manufacturer's latest standard design. Where two or more units of the same class of equipment are required, these units shall be the products of the same manufacturer. However, the component parts of the systems need not be the products of the same manufacturer. Specific equipment specified hereinafter is to be considered a standard of quality and operation. In general, all capacities of equipment, and motor and starter characteristics are shown in schedules on the drawings. Reference shall be made to the schedules for specific information. The capacities shown are minimum capacities. Variations in the characteristics will be permitted only on written approval of the Architect/Engineer. All equipment shall be shipped to the job with not less than a prime coat of paint or as specified hereinafter. Insofar as is possible all items of the same type (i.e., pumps, fans, etc.) shall be by the same manufacturer. Where installation instructions are not included in these specifications or on the plans, the manufacturer's instructions shall be followed. All equipment affected by altitude shall be rated to operate at the altitude where it is to be installed.
- J. Excavation and Backfilling: This Contractor shall do all necessary excavation and backfill for the installation of the Mechanical systems as may be required. Curb cuts, asphalt, and concrete patching, cutting and patching existing floor, etc., shall be part of this Contractor's responsibility. No extra payment will be made for rock excavation. Trenches for all underground piping shall be excavated to the required depths. The bottoms of trenches shall be tamped hard and graded to secure maximum fall. Bell holes shall be excavated to assure the pipe resting for its entire length on solid ground. Should rock be encountered, it shall be excavated to a depth of 6 inches below the bottom of the pipe, and before laying the pipe, the space between the bottom of the pipe and the rock surface shall be filled with gravel, thoroughly tamped. Pipe laid in trenches dug in fill shall be supported down in the trenches and shall be filled. No roots, rocks or foreign materials of any description shall be used in backfilling the trenches. The backfill material shall be identical to the surrounding fill material and shall be placed in 6-inch

layer, wetted, and compacted to the density of the adjacent soil. See Division 2 for additional information for site utilities. All surplus materials shall be hauled from the project by the Contractor at his expense.

K. Cutting and Repairing:

1. Responsibility of the Contractor whose work is involved. Coordinate with others to prevent unnecessary cutting and repairing.
2. Lay out and locate equipment, openings, and chases. Install sleeves, inserts, and supports. Arrange with those whose work is involved to do cutting and replacing caused by negligence or error with costs reimbursed by the Contractor at fault. Cutting and replacing of existing work shall be the responsibility of the Contractor whose work is being installed.
3. Removal or terminating connections of existing work which is abandoned or replaced shall also be done hereunder to provide correct and finished work.

L. Foundations: All equipment shall be provided with suitable foundations and supports. It shall be the responsibility of the Contractor to provide for the proper locations of these foundations and supports. This applies to all rooftop equipment also.

1. All concrete foundations required by equipment furnished by the Mechanical Contractor shall be constructed by them (except where otherwise noted) the conformity with the recommendations of the manufacturer of the respective equipment, and with the approval of the Architect/Engineer. All corners of the foundations shall be neatly chamfered. Foundation bolts shall be placed in the forms when the concrete is poured. Allow 1 inch below the equipment base for alignment, leveling and grouting with non-shrinking grout. Grouting shall be done after the equipment is leveled in place. After the grout has hardened, the foundation bolts shall be pulled up tight and the equipment shimmed, if necessary. After removal of the forms, the surface of the foundation shall be rubbed.
2. Unless otherwise noted, foundations shall be a minimum of 6-inch high. All concrete work performed by these Contractors shall conform entirely to the requirements of the Concrete Specifications which describe this class of work.

M. Code Requirements: Comply with state and local code requirements and ordinances. Call for inspections required by responsible building inspection authority.

N. Applicable Building Codes and Ordinances: Including the latest edition of each code, but not limited to the following:

1. International Building Code.
2. Uniform Mechanical Code.
3. Uniform Plumbing Code.
4. Governing Fire Department Requirements
5. Utility Company Requirements
6. National Fire Protection Association Standards
7. NFPA 70 - National Electrical Code
8. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
9. NEPA 90B - Installation of Warm Air Heating and Air Conditioning Systems

10. NFPA 13 - Sprinkler Systems
 11. NFPA 101 - Life Safety
 12. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment
 13. International Energy Conservation Code 2018
- O. Access Panels
1. Similar to Milcor, or as noted on the drawings, size as required for concealed expansion joints, valving, gauges, balancing dampers, valves, traps, pitot stations, equipment and similar items requiring accessibility. Notify the General Contractor of each access panel location and the required size. Panels shall be proper type for ceiling or wall in which they are installed. The panels shall be furnished under this section of the Specifications, unless otherwise directed, but shall be coordinated to be compatible with walls and ceilings furnished under other sections.

1.9 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Division 1
- B. Large Items: make arrangements with other trades on the job for introduction into the building of equipment too large to pass through finished openings.
- C. Acceptance: Check and sign for materials to be furnished by others for installation under all Mechanical Divisions upon delivery. Contractor shall be responsible for the storage and safekeeping of such materials from time of delivery until final acceptance.
- D. Protection: Close ends of pipe and ductwork at the close of each working day during construction to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Protect fixtures and equipment against damage during mechanical work with heavy paper or plastic until final clean-up.
- E. Storage: Store equipment in covered enclosure or wrap with weather tight 6 mil Visqueen.
- F. Shipping Protection: Protective casings, crating, and coverings to remain in place until start-up of equipment.

1.10 PROJECT CONDITIONS

- A. Performance: All systems are to be rated at 4,500 ft. elevation.

1.11 SEQUENCING AND SCHEDULING

- A. General: Comply with Division 1.
- B. Schedule: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.

- C. Utility Interruptions: Schedule mechanical utility interruptions with the Architect/Engineer/Owner minimum of seven (7) days prior to the requested outage. Plan work so that duration of the interruptions a maximum of one day.

1.12 CONTROLS WIRING AND ELECTRICAL EQUIPMENT

- A. All mechanical equipment controls wiring, conduit, relays, interlocks, and all accessories required for a completely operational controls system shall be the complete responsibility of the mechanical contractor. The mechanical contractor has the option to hire the project electrical contractor or any qualified controls contractor to install mechanical controls wiring and conduit. Refer to specification 251000 for installation requirements.
- B. Electrical items such as disconnect switches and motor starters associated with equipment provided by Division 23, when specifically mentioned to be furnished by the Mechanical Contractor, whether in these specifications or on the Electrical or Mechanical Drawings, shall be furnished by the Contractor. These items shall be mounted and connected as required for a completely operational system. See Control Systems Specification for further information.
- C. All electrical equipment characteristics (voltage, etc.) must be verified by the Contractor prior to ordering. If the Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, he shall first inform the Architect/Engineer of the change and shall then coordinate the change with the Electrical Contractor and shall pay all additional charges in connection with the change.
- D. All motors shall meet all the requirements of all Electrical Divisions.
 - 1. All motors shall be built in accordance with the current applicable IEEE, ASA, and NEMA standards. All general-purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. All motors shall have copper windings. All motors to have minimum power factor of 85% or have switched correction to 90%. Unless indicated otherwise, motors shall be NEMA design B with a service factor of 1.15 with 40°C rise and total temperature rise of 65°C ambient and when powered from the system voltage feeding the motor. TEFC motors shall a service factor of 1.00 with total temperature is of 65°C in the above conditions. Motors located in areas exceeding 40°C ambient shall be factory-rated for the ambient temperature of the motor environment. Single phase motors shall generally be NEMA Type N split phase induction motors with built-in thermal protectors. Single phase motors connected on loads requiring high starting torque shall be capacitor-start induction motors. Single phase motors of 1/10 HP or less may be shaded pole induction motors.

1.13 PROTECTION AGAINST HAZARDOUS CONDITIONS

- A. The Contractor shall take precautions against hazardous construction conditions at all times during construction. The final condition of the facilities shall be safe, and where safety to operating personnel is jeopardized, suitable signage shall be posted.

- B. Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operating personnel, shall be cut back and/or protected to reduce the risk of injury. All openings between floors shall be protected with barriers around the openings, gratings across the openings, or steel bars through the openings to avoid and protect against injury.

1.14 HAZARDOUS SIGNS

- A. Equipment room contains moving or rotating parts, floor openings, or other potentially hazardous environments and shall include a sign on the door entering it that shall read similar to the following: **Hazardous Area - Authorized Personnel Only.**

1.15 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. The Mechanical Contractor shall furnish to the Owner a bound (three (3) ring binder) manual in triplicate, containing complete repair parts lists, and operating, service, and maintenance instructions on all mechanical equipment, fixtures, and systems, as noted below:
 - 1. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect/Engineer, Sub-consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
 - 2. For Each Product System: List names, addresses and telephone numbers of Sub-contractors and suppliers, including local source of supplies and replacement parts.
 - 3. Product Data: Mark each sheet to clearly identify specific product and component parts, and data applicable to installation. Delete inapplicable information.
 - 4. Warranties and Bonds: Bind in copy of each.
 - 5. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
 - 6. Include color-coded wiring diagrams as installed for control system.
 - 7. Operating Procedures: Include start-up, break-in and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.
 - 8. Maintenance Requirements: Include routine procedures and guide for troubleshooting, disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - 9. Provide servicing and lubrication schedule and list of lubricants required.
 - 10. Include manufacturer's printed operation and maintenance instructions.
 - 11. Include sequence of operation by controls manufacturer.
 - 12. Provide original manufacturer's part list, illustrations, assembly drawings and diagrams required for maintenance.
 - 13. Provide control diagrams by controls manufacturer as installed.
 - 14. Provide charts of valve tag numbers, with locations and functions of each valve, keyed to flow and control diagrams.

15. Provide list of original manufacturer's spare parts and recommended quantities and to be maintained in storage.
 16. Include Test and Balance (T&B) Reports as specified in Section 230593.
- B. The Mechanical Contractor shall also provide training as required by Section 230100 to the Owner's operation and maintenance personnel.

1.16 OPERATION PRIOR TO ACCEPTANCE

- A. The Owner shall have the right to operate any and all apparatus as soon as and as long as it is in operating condition, after Owner personnel have received operational training, whether or not such apparatus has been accepted as complete and satisfactory, except that this shall not be construed to mean operations before any required alterations or repairs have been made. This operation does not indicate acceptance of the equipment by the Owner. When the Contractor enters into a contract with the Owner, he agrees to the above.

1.17 WARRANTY AND SERVICE PROGRAM

- A. Due to the critical performance requirements and to clearly establish warranty responsibility for this project, the Contractor shall provide a full-service maintenance and warranty program to the Owner for one full year after beneficial occupancy (substantial completion).
- B. This service program shall be included as part of the base bid and shall include service, maintenance, repair, replacement, lubrication, temperature control calibration and repairs, and documenting proof for all service and maintenance work on all equipment and system furnished by the Contractor.
- C. A single representative in the employment of the Contractor shall be responsible for coordination and follow through of this program. This representative's name and phone number shall be submitted to the Owner as part of the maintenance manuals and supportive data. The Contractor shall respond to a request for service with 24 hours if so requested.
- D. During this first year of operation, the following sequence of maintenance service shall be performed as a minimum.
1. Clean strainers in piping.
 2. Fans and/or pumps be lubricated and oiled once every four (4) months.
 3. Controls shall be calibrated throughout the facility at the end of six (6) months (following substantial completion). Any leaks in the piping systems shall be repaired.
 4. All equipment manufacturer's service recommendations shall be followed during this period.

1.18 FLUSHING AND DRAINING

- A. It shall be the responsibility of this Contractor to properly drain and flush all ducts and pipes before use or acceptance to ensure that all debris is completely removed. Damage

caused by such debris remaining in the ducts or pipes shall be repaired by this Contractor at his expense. This Contractor shall demonstrate to the Architect/Engineer's representative that all piping is clean.

1.19 CLEANING

- A. This Contractor shall remove from the building construction site all rubbish and dirt as it accumulates under the contract. At completion, all areas shall be broom cleaned and all obstructions, surplus materials, etc., removed.

1.20 GUARANTEE

- A. The Contractor shall guarantee all materials, equipment, and workmanship furnished and installed by him under this Contract, to be free from all defects of workmanship and materials, and shall agree to replace at his expense, without expense to the Owner, at any time within one year after installation is accepted by the Architect/Engineer, any and all defective equipment, parts, etc., that may be found. (This excludes normal maintenance and daily servicing of equipment which is the Owner's responsibility.)

1.21 FLOOR, WALL, AND CEILING PLATES

- A. Where exposed pipes pass through floors, finished walls, or finished ceiling, they shall be fitted with chromium-plated escutcheons of an approved pattern. Escutcheons and plates in Mechanical Rooms do not require chrome finish.
- B. This Contractor shall be responsible for providing and installing all counter flashing. All openings in the roof shall be flashed and counter-flashed. Use four-pound lead flashing materials for all vent lines and welded flashing in steel lines passing through roof. The Mechanical Contractor shall notify the General Contractor where each roof penetrations are and the size of the opening.

1.22 PIPE SLEEVES

- A. Schedule 40 steel pipe sleeves or pipe sleeves made of No. 20 gauge galvanized steel, properly secured in place with approximately 1/4" space between each sleeve and the surface of the pipe and/or insulation passing through it, shall be provided for all pipes passing through concrete floors, roofs, and masonry walls. All pipe sleeves shall be fixed in place as the walls and floors are built up. The Contractor shall furnish and locate all sleeves and pipes passing through concrete floors, exterior masonry walls, and roofs shall be made watertight with approved non-hardening plastic material. Sleeves through pipe chase or equipment room floors shall project a minimum of 2-inch above the floor and shall be of black steel pipe with waterproof flange at center of floor thickness. Each sleeve through a fireproof wall shall be packed with approved fireproof rope in the annular space.

1.23 PIPE HANGERS

- A. Pipe hangers shall be Fee and Mason of a type suitable for each use. Perforated straps shall not be used in any work. For ferrous pipes up to and including 4 inch in size, use Fee and Mason Fig. 199 malleable iron, adjustable, split ring, swivel hanger. For

plumbing piping larger than 4 inch, use Fee and Mason Fig 239 steel clevis hanger. Where several pipes are parallel at the same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be supported on rollers where indicated on the Drawings. For copper pipes up to and including 3 inch in size, use Fee and Mason Fig. 360 malleable iron, copper plated hangers. For copper pipes larger than 3 inch, use Fee and Mason Fig. 364 copper plated clevis hanger.

B. Hanger rod sizes shall conform to the following schedule:

1.	Pipe up to and including 2"	3/8" rods
2.	Pipe 2-1/2", 3" and 3-1/2"	1/2" rods
3.	Pipe 4" and 5"	5/8" rods
4.	Pipe 6"	3/4" rods
5.	Pipe 8", 10", and 12"	7/8" rods

C. Unless shown otherwise on the Plans, all horizontal runs of ferrous piping shall be suspended from the floor or roof construction, as the case may be, by means of hangers with the following spacing:

1.	Pipe up to and including 1-1/4"	8'
2.	Pipe 1-1/2" and 2"	10'
3.	Pipe 2-1/2" and 3"	12'
4.	Pipe 3 1/2" and 4"	14'
5.	Pipe 5" and 6"	16'
6.	Pipe 8" and 10"	20'

D. Unless shown otherwise on the Plans, all horizontal runs of copper piping shall be suspended from the floor or roof construction as the case may be, by means of hangers with the following maximum spacing:

1.	Pipe up to 3/4" in size	5'
2.	Pipe 1" and 1-1/4"	6'
3.	Pipe 1-1/2" and larger	10'

E. There shall be a hanger within 2 inches of each elbow or tee. Additional supports shall be provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length of pipe. Vertical risers shall be supported by approved riser clamps at each floor. Vertical pipes within a space shall have not less than two supports.

F. Supports and hangers shall be installed to permit free expansion and contraction in the piping systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to control expansion and contraction, the piping shall be guided and firmly anchored. No piping shall be self-supporting, nor shall it be supported from equipment connection.

G. Hanger rods for all equipment, pipes, ducts, trapezes, vibration isolators, etc., shall be installed straight, true and plumb. Do not bend or flex hanger rods to accommodate sloping structures, avoid obstacles, or for any other purpose. Where necessary, utilize swivel beam clamps, beveled or swivel hardware, angled, swivel or hinged brackets spanning members or other appropriate means of connection.

- H. Expansion bolts shall be Ackerman-Johnson or Hilti.
- I. Beam clamps suitable for use with this type of steel construction involved shall be Grinnell.

1.24 PRESSURE VESSEL CERTIFICATION

- A. Not used.

1.25 ISOLATION

- A. Excessive vibration or objectionable noise created in any part of the building by the operation of any equipment furnished and/or installed under the Mechanical Contract will be extremely objectionable and the Contractor shall take all precautions against the same by isolating the various items of equipment from the building structure and by such other means as may be necessary to eliminate all excessive vibration and objectionable noise produced by any equipment installed by them, and consequently, they shall design all foundations, supports, etc., for their equipment, and all piping with this end in view. In addition, these Contractors shall supervise the construction of all foundations and supports, whether they build them or not, in order that they may be constructed in such a manner as to prevent the transmission of objectionable noise and/or excessive vibration. Submit calculations on all vibration isolation equipment.

- B. All equipment having moving parts shall be isolated from the building structure by means of Korfund isolation materials, unless specifically noted otherwise. All isolators shall be the same brand and shall be supplied from the same source. Equipment manufacturer's recommendations shall be followed in the isolation of equipment.

- C. Vibration isolators shall have sufficient resilience to meet the following minimum efficiencies:

<u>Motor HP</u>	<u>Equipment Room</u>
Up to 5	90%
7-1/2 to 15	93%
20 to 40	95%
50 to 100	97.5%

- D. Spring isolators shall be of the housed type with ribbed pads bonded to the underside of the baseplate or may be unboxed stable springs. Isolators shall be furnished with snubbers and limit stops where so recommended by the equipment manufacturer.

- E. The Supplier of the isolating equipment shall, upon completion of the job, check all isolating materials and verify that they are installed properly, and submit a report in writing to the Architect/Engineer.

1.26 TESTING

- A. Before completion of this project, the Mechanical Contractor shall test all materials and equipment which normally require testing. All piping, etc., shall be tested to meet code requirements or the Specification requirements, whichever is more stringent.

- B. All equipment shall be operated sufficiently long enough to prove to the Architect/Engineer that the equipment performs satisfactorily and meets the requirements set forth on the Plans or in these Specifications.

1.27 CERTIFICATIONS

- A. Before receiving final payment, the contractor shall verify that all equipment furnished, and all work done is in compliance with all applicable codes mentioned in these Specifications. Submit certifications and acceptable certificates to the Architect/Engineer.

1.28 GENERAL PIPING INSTALLATION REQUIREMENTS

- A. Provisions for Drainage: All piping systems shall be installed so that they may be easily drained. Drain caps, plugs, or hose bibbs shall be installed at low points. Grade piping toward drain locations.
- B. Alignment: All installed pipelines shall be straight and shall remain straight against strains. Proper allowance shall be made for expansion and contraction.
- C. Clean as Installed: All piping shall be kept free from scale or loose dirt when installed and must be kept clean during the completion of the installation. All openings in the piping system shall be capped or plugged while awaiting further connections. All detergents, solvents and other cleaning agents shall be compatible with the materials of fabrication of the system in which they are used. They shall not adversely affect the materials of mechanisms in the systems and they shall be acceptable to equipment manufacturers. All detergents, solvents, and other cleaning agents shall also be compatible with the process streams to be handled by the systems in which they are used.
- D. Insulated Fittings: Install between any dissimilar metals such as steel and copper.
- E. Expansion and Contraction: The Contractor shall make all necessary provisions for expansion and contraction with proper fittings, anchors, dresser couplings, loops, etc. Install flexible connectors on each pipe at each building expansion joint.
- F. Welding: Refer to Paragraph 1.29 of this section of these specifications.
- G. Bending: No bending of pipe will be permitted.
- H. General: The installation shall be coordinated with respect to space available with heating, cooling, ventilating, and electrical installation. In every instance where there is a conflict in the routing of the piping and the ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows, shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Cutting or weakening of structural members to facilitate piping, installation is not permitted. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall be run parallel with the lines of the building unless otherwise noted on the drawings. Unless

otherwise shown on the drawings, horizontal piping shall pitch down in the direction of flow with grade of not less than 1 inch in 40 feet. Piping connections to equipment shall be in accordance with details shown on the drawings or as recommended by the equipment manufacturer. Service pipe valves and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 1/2 inch from such other work, and not less than 1/2 inch between finished covering on the different services.

- I. Installation of Valves: Valves shall be installed at the locations shown on the drawings and where specified and where directed at site. Gate valves shall be used unless otherwise shown, specified, or directed. All valves shall be installed with their stems horizontal or above. Where tight shutoff is required, a composition seat globe valve or resilient seat ball valve shall be used.
- J. All valves which must be used during operation, all control valve assemblies, instrument control cases, liquid level controls, gage glasses, orifices, relief valves, and other equipment which must be observed, adjusted, or serviced during operation shall be located conveniently accessible from an operating platform or grade.
- K. In general, relief valves within processing unit limits shall be located conveniently accessible from an operating platform or grade.
 - 1. Those in non-hazardous service, such as water, shall discharge directly to outside.
 - 2. Relief valves should have no piping between the vessel or line and the valve inlet, except as shown on the drawings.
 - 3. Relief valves shall be installed in a vertical position. Vent piping shall be braced and supported in a manner that will not produce excessive stresses in the relief valve and will permit removal of the relief valve without necessary temporary supports for the vent lines.
- L. Equipment Connections: All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment. The contractor shall be required as directed to remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected. Pipe connections to equipment shall be made with unions or flanged fittings. Provide removable headers for large equipment for service access.
- M. Joints
 - 1. Flanged Joints: All flanged joints shall be face matched. Raised face flanges shall not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be turned off. All flanged bolt holes shall straddle the horizontal and vertical center line unless otherwise noted.
 - 2. Screwed Joints: Screwed pipe joints shall have American Standard Taper Pipe Threads ANSI-B2.1 Latest Edition. Burrs formed when cutting pipe shall be removed by reaming. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. Joints shall be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound.

3. Solder-Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool or wire brush before seating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for serrated fittings on water, compressed air below 60 psig, and vacuum lines shall be made with a 95 percent tin and 5 percent antimony. Cored solder or solder containing lead will not be permitted.
- N. Reducers: Reduction in pipe size shall be made with one piece reducing fittings. Bushings reducing at least two pipe sizes will be acceptable only when there is no room for reducing couplings or swaged nipples.
- O. Unions: All piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings specified with which they are used. Union Pressure classes and end connections shall be the same as the fittings used in the lines with the unions. Steel unions shall have hardened stainless steel seating surfaces on both faces.
- P. Hanger Supports:
1. All hanger rods used to support piping, conduit, mechanical units, equipment, trapezes, and other items shall be straight and installed plumb, regardless of length. Do not bend rods to adapt to sloped or rotated structural members, secondary support members or to sloped mounting holes on supported equipment. Contractor shall utilize available swivel, hinged, or rigid mounting techniques designed to accommodate a slope or rotation, or shall design a custom solution. Selected techniques for each application shall be submitted for approval prior to use.
 2. Do not bend rods to circumvent an obstruction.
 3. Loads on hanger rods shall be applied in direct tension. Do not apply compression, lateral or moment loads to hanger rods. Install bracing or additional supports to prevent hanger rod from incurring non-tension loading.
 4. Do not create offsets in rods; use only in-line couplers, and only when length of coupled rod exceeds standard available length (typically 12 feet), or when full lengths cannot be placed in position. Provide additional horizontal bracing to prevent swaying of supported piping or equipment.
 5. Do not straighten bent rods for subsequent use. If a rod becomes bent, cut off and discard the bent portion. Remaining straight portion of rod may be used.

1.29 WELDING

- A. All welding of piping covered by this specification, regardless of condition of service shall be accompanied as follows:
1. The welding shall be in accordance with the recommendations of the American Welding Society. Mitering of pipe to form elbows, notching to form these, or any similar construction will not be permitted. Welding fittings shall be installed on all welded lines. Joints to be welded shall be properly aligned and spaced, using special welding clamps where necessary. All welders to be employed shall have passed qualification tests prescribed by the National Certified Pipe Welding

bureau (or by another reputable testing laboratory or agency) using procedures approved by the American Society of Mechanical Engineers or the American Welding Society. The welders will be required to pass qualification tests when the work of the welder creates a reasonable doubt as to his proficiency. Tests shall be conducted at no additional expense to the Owner.

2. Each welder shall, in addition to having passed the prescribed qualification tests (as noted in Paragraph 1.30.A.1), prepare sample coupons at the job site on a portion of pipe that is cut such that the cross section of the weld is opened to view. The sample weld should be prepared using a 6-inch diameter pipe. The sample shall reflect a continuous weld with perpendicular cut out to show the weld in cross sectional view. This sample, when accepted and approved by a certified welding inspector, shall be used as a standard of quality to compare to other welds that this welder will be performing on the job. This same sample weld will also be a basis for accepting or rejecting the welder for working on this project. The sample weld shall be identified with a date and the welder's name and shall be kept at the site throughout the project.
3. All welding on pressure piping shall conform to all of the requirements of the American Society of Mechanical Engineers Code for Pressure Piping - B31.1 (An American National Standards Institute publication), as defined in the latest edition of the ANSI Power Piping B31.1 Manual. All welding shall also conform to all of the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. All chapters, current addenda and supplements of these manuals shall apply. This code shall be used to establish standards of performance and quality of welds. However, the Owner reserves the right to perform radiographic testing of all welds, to compare any of the welds to the approved "standard" sample welds of each welder, and to compare the welds to the welding diagrams and sketches of those recommended in the ANSI B31.1 Power Piping Manual. The intent is to obtain the highest quality welding job possible. The cost of any initial radiographic testing, for random inspection, shall be paid for by the Owner. If radiographic random testing reveals that a weld is defective, the Contractor shall bear the cost of all repairs and re-testing necessary to be made to subject weld until conformance with radiographic tests is reached. The potential for random radiographic testing and welding quality control applies to all pressure piping systems in this project, including systems below 100 psig. If a question should arise regarding the possibility of faulty welding or if there are obvious visual defects in the welding, the Contractor shall be required to correct such deficiencies to a quality level consistent with the recommendations, welding diagrams and sketches in the ANSI B31.1 Manual. The quality level shall also reflect that of the approved sample welds accomplished by each welder for this particular project.

1.30 TESTING FOR PIPING SYSTEMS

- A. General: Before insulation is applied, all piping, equipment, and accessories installed under this contract shall be inspected and tested by the Contractor. All labor, material, and equipment required for testing shall be furnished by the Contractor. The Contractor shall be responsible for all repairs and retesting as required. All instruments and other equipment whose safe pressure range is below that of the test pressure shall be removed from the line or blanked off before applying tests. Prior to performing tests, all lines shall be "blown" free of all loose dirt and foreign particles. The lines shall then be thoroughly

flushed with water (liquid lines only) at a sufficient flow rate and period of time, to ensure complete cleaning of the lines of all dirt, scale, and foreign matter. Satisfactory flushing of the lines shall be subject to approval. After testing and flushing lines, all filters and strainers shall be cleaned.

- B. Safety: Since the Risk of failure, with the attendant possibility of injury, is appreciable greater with further testing, all safety measures required by codes or ordinance or reasonable applicable to the situation shall be taken.
- C. Concealment: Equipment or piping to be pressure tested shall not be insulated, covered, or concealed prior to that test. Compression joint underground piping may be backfilled prior to pressure test except that joints shall remain exposed until after the test, but tie rods, clamps, etc., shall be in place and fastened.
- D. Pressure Ratings: These tests shall not be used to establish pressure ratings.
- E. System Protection: Protect all piping and equipment against overpressure, collapse from vacuum, and hydraulic shock during the filling, testing, and draining procedures. Seats of iron valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Pressure tests against other closed valves shall not exceed twice the normal rating. Note that where significant differences in elevation exists, there is a risk of overpressure in the lower portions of the system in order to attain test pressure in the upper portion of the system
- F. Test Temperature: Apply test pressure only after the system and test medium are at approximately the same temperature, preferably not less than 60°F. Note that some applicable codes require testing above a specified minimum temperature.
- G. Sectionalizing: Systems may be separated into sub-systems for testing if such action will expedite or simplify the testing.
- H. Temporary Supports: During hydrostatic testing of lines provide temporary supports to prevent overstressing supports or hangers. When tests are completed, remove all temporary supports, locks, stops, etc., and adjust supports for their cold load and alignment.
- I. Testing: Domestic hot and cold-water piping and heating water piping shall be tested hydrostatically at the test pressures specified and shall show no drop in pressure in a 2 hour period. Leaks shall be located by soap testing
 - 1. Test Pressures:
 - a) Condenser or Tower Water Supply & Return: 100 psig.
 - b) Heating Water Supply and Return: 100 psig.
 - c) Chilled Water Supply and Return: 100 psig.
 - d) Steam and condensate (low pressure): 125 psig.
- J. Test Report
 - 1. A detailed report of pressure tests on piping and equipment shall be forwarded in duplicate to the Architect/Engineer. This report shall show date of test, lines

tested, test medium, length of time test pressure was held, pressure drop or rise, and extent of venting or repressurizing.

1.31 COOPERATION WITH OTHER TRADES

- A. The Contractor shall refer to other sections of these specifications covering the work of other trades which must be carried out in conjunction with the mechanical work so that the construction operations can proceed without harm to the Owner from interference, delay, or absence of coordination.

1.32 FIELD MEASUREMENTS

- A. The Contractor shall verify the dimensions covering the mechanical work at the building. No extra compensation shall be claimed or allowed on account of difference between actual dimensions and those indicated on the drawings. He shall examine the adjoining work on which Mechanical work is dependent for maximum efficiency and shall report any work which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting Mechanical work.

1.33 SAFETY GUARDS

- A. The Mechanical Contractor shall furnish and install safety guards required in order to obtain certificates of inspection from all authorities having jurisdiction. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded. Provide coupling guards on all rotating shafts.

1.34 PROTECTION

- A. All work, equipment, and materials shall be protected at all times to prevent obstruction, damage, or breakage. All pipe openings shall be closed with caps or plugs during installation. All equipment shall be covered and protected against dirt, water, chemical, or mechanical injury. At the completion of the work, all equipment shall be thoroughly cleaned, and the entire system shall be delivered in a perfect, unblemished condition.

1.35 PAINTING AND IDENTIFICATION

- A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be marred in transit or during installation, it shall be finished to present a neat, workmanlike appearance.
- B. Except as elsewhere hereinafter specifically required, any painting of equipment, piping, ductwork, grilles, insulation, etc., furnished and installed under this Section of the Specifications will be done by the Painting Contractor. However, the Mechanical Contractor shall leave his equipment clean and free from any grease, dirt, rust, etc., and in suitable condition for painting.
- C. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during the painting operation.

- D. The piping shall be painted the basic color as indicated in other sections of these specifications and shall be marked every 10 feet on centers with Brady pipe markers. Arrows, approximately 6 inch in length and spaced about 10 feet on centers shall indicate the direction of the flow pipe. Locate additional labels as required in Mechanical Rooms. Staple in place, brush with clear lacquer. Markers shall state pipe size, flow direction, and pipe usage (such as "cold water," etc.).

1.36 RECORD DRAWINGS

- A. The Contractor shall, during the execution of the work, maintain a complete set of drawings upon which all dimensional locations of equipment piping and all deviations and/or changes in the work shall be recorded. Water, storm, and drainage mains shall be delivered to the Architect/Engineer in good condition upon the completion and acceptance of the work and before final payment is made.

1.37 SUPPLIER RESPONSIBILITY

- A. Each supplier, whether furnishing equipment as specified or as a substitution shall be responsible for certifying that the equipment is properly installed and that the warranty is valid. Submit written reports on the installation and the equipment performance when requested to do so by the Architect/Engineer (or his representative). Each supplier shall be responsible for furnishing qualified personnel at the job site at anytime requested by the Architect/Engineer (or his representative) during the construction or warranty periods.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. It is the intent of this specification to define all motors furnished under all sections of the specifications for this project which will provide efficient operation, reliability, ease of maintenance, and repair along with reduced operation costs.
- B. All general-purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. Motors shall be rated explosion-proof when located in hazardous atmospheres.
- C. Motors mounted in direct sun shall be provided with a shield to forbid direct radiation from the sun when the sun is 45 degree or greater above the horizon.
- D. All supply fan motors mounted in air handling units shall have Class F insulation.
- E. Open drip-proof motors shall be NEMA design B with Class B insulation and a 1.15 service factor with 40 degrees C ambient and a total temperature rise of 65 degrees C.
- F. TEFC motors shall be NEMA design B with Class F insulation and a 1.15 service factor with 40 degree C ambient and a total temperature rise of 65 degrees C.
- G. Severe duty motors shall be NEMA design B with Class F insulation and a 1.15 service factor with 40 degrees C ambient and a total temperature rise of 65 degrees C.

1.3 GENERAL

- A. All motors covered by this specification shall conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC Standards. They shall be free from defective material and workmanship and fully capable of performing in accordance with the manufacturer's nameplate rating.
- B. Motors shall be approved by Underwriter's Laboratories (UL) for the service specified.
- C. Unless otherwise specified, motors shall be suitable for operation in either direction-- (CW or CCW) or rotation.
- D. Motors shall be Westinghouse II, Reliance XE, Gould E-PLUS, GE Energy Savery, or approved equal.

- E. All fractional H.P. motors shall be permanent split capacitor (P.S.C.) with U.L. listed overload protection. The protector shall be calibrated to trip out when the winding reaches a pre-determined temperature and automatically reset when the temperature returns to a safe limit.

1.4 EFFICIENCY

- A. All motors shall be special high efficiency design. These motors shall be different than manufacturers' standard product, in that losses are reduced by incorporation of design features including the use of low loss lamination steel, increase in stator/rotor length, increase in copper windings, utilization of high efficiency ventilating fan, computer optimized slot configuration and air gap.
- B. All motors shall be all copper wound, high power factor, high efficiency motors. Motor efficiency shall be as determined by IEEE Standard 112A, test method B. Test results shall be submitted to the Engineer.
- C. Manufacturer to furnish % efficiency, % PF, amps at Full Load, 3/4 Load, and 1/2 Load with quotation and be prepared to furnish actual test results on individual ratings if required.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Motors shall be 60 Hertz voltage as indicated on drawings, Squirrel Cage induction type suitable for across-the-line starting and continuous duty.
- B. Motors shall have copper windings.
- C. All motors shall be suitable for application without exceeding Class B rise in ambient temperatures up to and including 65 degree C at 1.15 Service Factor. Motor nameplates shall state suitability for 65 degree C ambient application.
- D. All motors shall be suitable for application without exceeding Class B temperature rise at altitudes up to and including 9900 feet at a 1.00 Service Factor.
- E. Motors shall operate successfully under running conditions at rated load with +10% of rated voltage or +5% of rated frequency or a combined variation in voltage and frequency of +10% (sum of absolute values).
- F. Motors will have at least a nominal 85% power factor rating at full load and rated voltage. Exclusion from this requirement are motors which draw less than 1,000 watts at full load and motors with synchronous speeds less than 1800 RPM. Test verification shall be available upon request.

2.2 INSULATION

- A. Motors shall have non-hygroscopic Class B or Class F insulation system as required; however, temperature rise shall not exceed Class B rise at rated load per NEMA Standards.
- B. The insulation system shall be provided with sufficient treatment so that the completed insulation system will have a minimum resistance of 1.5 megohms after 168 hours of testing to a humidity chamber maintained at 100% relative humidity and 40 degree C ambient.

2.3 TESTS

- A. Each motor shall be given a routine factory test per NEMA and ASA Standards to ensure compliance with this specification.

2.4 BEARINGS

- A. Bearings shall be shielded, regreasable, vacuum degassed steel ball bearings, specially selected for electric motor service and long-life expectancy (B-10 MINIMUM).
- B. Bearings shall be lubricated with a premium moisture resistant grease formulated to operate over a temperature range of -20 degrees F to +300 degrees F.
- C. Bearing identification by AFBMA number shall be shown on motor nameplate.

2.5 ENCLOSURES

- A. Construction shall be of rugged corrosion resistant metal including a one-piece frame, brackets, conduit box and fan shroud.
- B. Fans shall be bi-directional and constructed of low inertia inert material.

2.6 CONDUIT BOXES

- A. Conduit boxes are to be diagonally split, rotatable in 90 degree turns, gasketed cast iron construction with threaded conduit holes.
- B. Ground lug suitable for grounding motor frame shall be furnished inside of conduit box.
- C. A neoprene lead seal separator gasket shall be mounted between motor frame and conduit box to prevent entry of moisture and dust into the motor.
- D. Conduit box size must meet or exceed minimum as shown in NEC Standards based on motor full load current.

2.7 HARDWARE

- A. Corrosion-resistant cadmium plated grease plugs shall be provided for relubrication of bearings.

- B. An external shaft flinger shall be provided on the shaft to prevent entrance of moisture or dust into the bearings.
- C. All motors Frame 182T and larger shall have lifting eyebolts for lifting the entire motor.
- D. An easy-to-read nameplate shall be provided on each motor and shall include at least the following information:
 - 1. Horsepower
 - 2. RPM
 - 3. NEMA Design
 - 4. Phase
 - 5. Hertz
 - 6. Service Factor
 - 7. Ambient Temperature
 - 8. Frame Size
 - 9. Duty
 - 10. Class of Insulation
 - 11. Locked KVA Code
 - 12. Full Load Amps
 - 13. Model or Catalog Number
 - 14. Bearing Identification
 - 15. Guaranteed Minimum Efficiency
 - 16. Nominal Efficiency
 - 17. Voltage

2.8 MOTOR CONSTRUCTION

- A. Motors shall be dynamically balanced to limits as indicated below:

Speed	Maximum Amplitude (Peak-to-Peak)
3500 & Above	.0010
1700 to 3499	.0015
Less than 1700	.0020

2.9 FINISH

- A. All external surfaces shall be prime painted with red oxide zinc chromate primer to prevent corrosion.
- B. The finish coat of paint shall be a full-gloss epoxy enamel paint. External finish shall protect against moisture and have superior heat resistance to withstand the effects of sunlight and outdoor weathering without chipping or cracking.

2.10 EFFICIENCY

- A. Motors furnished shall meet or exceed the efficiency listed on the following Table.

HIGH EFFICIENCY MOTORS

HP	3600 RPM EFFICIENCY		1800 RPM EFFICIENCY		1200 RPM EFFICIENCY	
	NOMINAL	MINIMUM	NOMINAL	MINIMUM	NOMINAL	MINIMUM
1	81.5	78.5	84.0	81.5	78.5	75.5
1.5	81.5	78.5	84.0	81.5	84.0	75.5
2	84.0	81.5	84.0	81.5	86.5	84.0
3	86.5	84.0	88.5	86.5	88.5	86.5
5	88.5	86.5	90.2	88.5	88.5	86.5
7.5	88.5	86.5	90.2	88.5	88.5	86.5
10	88.5	86.5	90.2	88.5	90.2	88.5
15	90.2	88.5	91.7	90.2	90.2	88.5
20	90.2	88.5	91.7	90.2	91.7	90.2
25	90.2	88.5	93.0	91.7	91.7	90.2
30	91.7	90.2	93.0	91.7	91.7	90.2
40	91.7	90.2	93.0	91.7	93.0	91.7
50	91.7	90.2	94.1	93.0	93.0	91.7
60	93.0	91.7	94.1	93.0	93.0	91.7
75	94.1	93.0	94.1	93.0	94.1	93.0
100	94.1	93.0	95.0	94.1	94.1	93.0
150	94.1	93.0	95.0	94.1	94.1	93.0
200	94.1	93.0	95.0	94.1	95.0	94.1
250	95.0	94.1	95.0	94.5	-	-

END OF SECTION 23 05 13

SECTION 23 05 19 - PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. The Contractor shall furnish and install all piping specialties necessary for satisfactory operation of the systems.
- B. Manual air vents shall be installed at all high points in heating and cooling water piping systems and as shown on the contract drawings.
- C. Valves shall be installed in all primary and secondary plumbing loops and branch lines feeding groups of fixtures in order to isolate such loops and branches without disrupting the service as a whole.
- D. Unions shall be installed where necessary to facilitate maintenance of pumps, valves, regulators, and other specialties.
- E. Dielectric unions shall be installed wherever dissimilar metals are joined, except valves in closed loop piping systems.

1.3 RELATED WORK IN OTHER SECTIONS

220523 VALVES
220700 PIPING INSULATION
221000 PIPE AND PIPE FITTINGS
230000 HEATING, VENTILATING, AND AIR CONDITIONING INDEX
230500 GENERAL HEATING, VENTILATING AND AIR CONDITIONING
REQUIREMENTS
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230548 VIBRATION ISOLATION AND EXPANSION COMPENSATION

PART 2 - PRODUCTS

2.1 STRAINERS

- A. Mueller Steam Specialty model 352M cast bronze, threaded ends, y-strainer, 20 mesh stainless steel screens for water service and .033" dia. opening screens for steam service. Provide blow-off valves full size of strainer tapping with drain lines to nearest drain.
- B. Mueller Steam Specialty model 752, 250 SWP, flanged for size 2-1/2" and larger with 1/16" dia openings screen for water and 3/64" dia openings stainless steel screen for steam. Provide blow-off valves full size of strainer tapping with drain lines to nearest drain.

2.2 PRESSURE GAUGES

- A. Marshalltown “Permagage”, Ashcroft “Duragage”, “Trerice No. 500X, or approved equal. Dials shall be 4-1/2” unless otherwise noted. Proved needle valve for each gauge, and syphon for each steam gauge. Pressure gauges shall be range noted on plans or at mid range of service (as shown on drawings).

2.3 THERMOMETERS

- A. Where indicated on the drawings and the piping diagrams, thermometers shall be installed as manufactured by the H.O. Trerice Co., Mueller, Albert Weiss, or approved equal. Thermometers shall be provided with expansion heads so that thermometer will not break under extremes of temperature. Each thermometer shall be provided with a separable socket well which shall be place in the piping system. The well shall be the length required for accurate reading of the thermometer.

2.4 AIR VENTS

- A. Manual air vents shall be 1/2” brass ball valves, Nibco No. T-585-70 or approved equal.

2.5 THERMOMETER WELLS

- A. Machined brass test wells with screwed caps and chains. H.O. Trerice No. 5573 or 5574 as required or approved equal.
- B. Temperature and Pressure Test Plugs: Furnish pressure and temperature test plugs at all locations as shown on the drawings and at every connection to each piece of equipment. These test plugs shall be furnished with a Nordel valve core and 1/2” NPT brass body complete with gasket cap.
- C. Furnish 4 each thermometers and pressure gauges for use by the Owner for checking temperatures and pressures.

2.6 INSULATING UNIONS

- A. Insulating unions having a plastic insert for electrical isolation shall be similar to EPCO Sales Company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All specialties shall be installed in accordance with the best standard practices and as recommended by the manufacturer.
- B. Where thermometers or test fittings occur in insulated piping systems or on insulated equipment, extension necks shall be provided to extend beyond the insulation.

- C. Dielectric union shall be installed wherever piping of dissimilar metallic material is connected. Insulating unions are not required between bronze valve bodies and connecting steel pipe in closed loop systems such as heating and chilled water systems.

END OF SECTION 23 05 19

SECTION 23 05 48 - VIBRATION ISOLATION AND EXPANSION COMPENSATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Vibration Isolation: All vibration isolation equipment including flexible pipe and duct connections hangers and bases shall be under the direct supervision of the vibration isolation manufacturer's representative. This specification provides the necessary design criteria to avoid excessive noise or vibration due to the operation of machinery, connecting piping, ductwork, or conduit.

1.3 RELATED WORK IN OTHER SECTIONS

220523 VALVES
220700 PIPING INSULATION
230000 HEATING, VENTILATING, AND AIR CONDITIONING INDEX
230500 GENERAL HEATING, VENTILATING, AND AIR CONDITIONING
REQUIREMENTS
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230519 PIPING SPECIALTIES
232113 HYDRONIC PIPING SYSTEMS

1.4 CONTRACTOR RESPONSIBILITY

- A. The Contractor shall provide a submittal to the Architect/Engineer for approval prior to any installation of his equipment containing the following information:
 - 1. Catalog cuts and data sheets on specific vibration isolators to be utilized showing compliance with this specification and the recommendation of the isolator manufacturer as to suitability for the specific service.
 - 2. An itemized list showing the items of equipment, piping and ductwork to be isolated, the isolator type and model number selected, isolator loading and deflection, and reference to specific drawings showing equipment frame construction where applicable.
 - 3. Drawings showing equipment frame construction for each machine, including dimensions, structural member sizes, support point locations, etc.
 - 4. Written approval of the frame design to be used, obtained from the equipment manufacturer.
 - 5. Drawings showing methods of suspension, support, guides, etc., for piping and ductwork.
 - 6. Drawings showing methods for isolation of piping and ductwork piercing walls, slabs, beams, etc.
 - 7. The Contractor shall bring to the Architect/Engineer's attention prior to installation any conflict with other trades which will result in unavoidable contact

to the equipment, piping, etc., described herein, due to inadequate space. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

8. The Contractor shall bring to the Architect/Engineer's attention any discrepancies between the specifications and field conditions, changes required due to specific equipment selection, etc., prior to installation. Corrective work necessitated by discrepancies after installation shall be at the expense of the Contractor.
9. The Contractor shall obtain inspection and approval from the Architect/Engineer of any installation to be covered or enclosed prior to such closure.
10. The Contractor shall obtain written and/or oral instructions from the vibration isolation manufacturer as to the proper installation and adjustment of vibration isolation devices; alternatively, the equipment may be installed by the vibration isolation manufacturer.
11. The Contractor shall correct, at no additional cost, all installations which are deemed defective in workmanship or materials by the contracting officer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Vibration isolation equipment shall be as manufactured by Flexonics, Kinetics, Mason Industries, Vibration Eliminator, Co., or approved equal.

2.2 ISOLATOR TYPES

A. Spring Type

1. All spring isolators shall have either known undeflected heights or other markings so that, after adjustment, when carrying their load the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.
2. All spring isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range 50% above the design deflection.
3. The ratio of lateral to vertical stiffness shall not be less than 1.0 or greater than 1.6.
4. The vertical natural frequency for each support point, based upon the load per isolator, and isolator stiffness, shall not differ by more than plus or minus 10%.
5. Type MS shall be bare spring type (without housings or snubbers) equipped with leveling bolts and with two layers of ribbed or waffled neoprene pad separated by a 1/16 " galvanized steel plate under the base plate.
6. Type HS shall be suspension hanger having a steel frame and spring element in series with a neoprene pad or washer. The isolator shall be designed so hanger rod may be misaligned 15 relative to the vertical without touching hanger box frame.

B. Neoprene Pad Type

1. Type MN shall be a neoprene isolator unit having a minimum static deflection of 1/4" and show hardness of 40 to 65 after minimum aging.

- C. Flexible pipe connectors shall consist of a minimum 12-inch length of metal reinforced or corrugated flexible metal hose of appropriate pressure and temperature rating with end connections suitably for the adjacent piping system. Connectors shall be Flexonics type MMT FLG or Vibrasorber or approved equal.
- D. Flexible duct connectors shall be neoprene coated glass fabric, ventglass, or equal. See Section 233000 AIR DISTRIBUTION.

2.3 EQUIPMENT FRAMES AND BASES

- A. General:
 - 1. Equipment frames and base shall be furnished and installed where specifically shown on the drawings and at other locations recommended by the isolator manufacturer. In general, rigid steel frames will be required for base mounted pumps, 30 HP and smaller, air handling units, some fans 30 HP and smaller, water chillers, cooling towers. Concrete inertia bases shall be furnished and installed for base mounted pumps 40 HP and larger and fans 40 HP and larger.
- B. Rigid Steel Frames
 - 1. Mounting frame and/or brackets shall be provided to carry the load of the equipment without causing mechanical distortion or stress to the equipment.
 - 2. The mounting frames shall consist of welded wide flange of channel structural steel with welded brackets to accept the isolators. The section depth of the frame member shall be greater than 1/10 the length of the longest frame member.

PART 3 - EXECUTION

3.1 GENERAL

- A. Location: Vibration isolation equipment shall be installed at the following locations and at other locations recommended by the isolator manufacturer or required to reduce transmitted vibrations to a level acceptable to the Architect/Engineer and Owner.
 - 1. All reciprocating or rotating equipment such as fans, AHU's, forced draft boilers, chiller, cooling towers, furnaces, pumps, and compressors except as follows:
 - a) Equipment installed on slab on grade construction.
 - b) AHU's having factory installed internal spring isolation at fans.
 - c) Inline pumps having motors 1/2 HP or smaller.
 - 2. At all connections between rotating equipment and piping or ductwork.
 - 3. All piping and ductwork within mechanical equipment rooms or within 10 feet of connections to rotating or reciprocating equipment.
- B. The Contractor shall install equipment and piping avoiding rigid contact with the building structure.
- C. The Contractor shall coordinate his work with other trades to assure rigid contact between the building structure and mechanical equipment and piping is minimized.

3.2 INSTALLATION

A. Large Equipment

1. Objective: Installation of vibration isolators shall not result in any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, equipment and piping shall be maintained in a rigid position during installation. Equipment shall be shimmed into final, loaded position prior to making piping connections. Equipment load shall not be transferred to the isolator until the installation is complete and the equipment is under full operational load. This is particularly important where equipment installation weight is substantially different from operating weight such as cooling towers, chillers, boilers, air washers and evaporative coolers which operate with substantial water content.
2. The machine to be isolated shall be supported by a structural steel frame or concrete inertia base.
3. Brackets shall be provided to accommodate the isolator and provide a mechanical stop. The vertical position and size of the bracket shall be specified by the isolator manufacturer.
4. The operating clearance at steel frames between the bracket and the pad or floor shall be 3/8 inch, plus or minus 1/16 inch. The minimum operating clearance between the frame and the housekeeping pad or floor shall be one inch.
5. The frame shall be placed in position and the brackets supported temporarily by 3/8-inch shims prior to the installation of the machine or isolators.
6. The isolators shall be installed without raising the machine and frame
7. After the entire system installation is completed and under full operational load, the isolator shall be adjusted so that the load is transferred from the shims to the isolator. When all isolators are properly adjusted the shims will be barely free and shall be removed. Thereafter, the shims will be used as a gauge to check that the 3/8-inch clearance is maintained so that the system will remain free of stress.

B. Pipe and Duct Hangers

1. General: Vertical rise and horizontally supported piping connected to reciprocating or rotating equipment are included herein. Domestic water and fire standpipe systems are excluded from this section of the specifications.
2. Pipe and duct hangers shall be suspended from spring isolators within mechanical equipment rooms and within 10 feet of connections to rotating or reciprocating equipment.
3. The isolators shall be installed with the isolator hanger box as close as possible to the structure.
4. The isolators shall be suspended from substantial structural members, not from slab diaphragms unless specifically approved.
5. Hanger rods shall be aligned to clear the hanger box.
6. Horizontal suspended pipe 2" and smaller shall be suspended by HS isolator type with a minimum 1.0-inch static deflection. Pipes larger than 2" shall be the same except with a minimum of 1-1/2" static deflection.
7. Horizontal pipe floor supported at slab shall be supported via Type MS with a minimum static deflection of 1.0 inch.

8. Vertical riser pipe supports shall utilize Type MS mounts selected for a minimum static deflection of 1.5 inches.
 9. Vertical riser guides, if required, shall utilize Type MN mounts to avoid direct contact of piping with building.
 10. Pipe sway braces where required shall utilize two neoprene elements (Type MN) to accommodate tension and compression forces.
 11. Hanger rods for all equipment, pipes, ducts, trapezes, vibration isolators, etc., shall be installed straight, true and plumb. Do not bend or flex hanger rods to accommodate sloping structures, avoid obstacles, or for any other purpose. Where necessary, utilize swivel beam clamps, beveled or swivel hardware, angled, swivel or hinged brackets spanning members or other appropriate means of connection.
- C. Pipe Clamps:
1. All piping whether or not spring isolated hangers are used, shall be supported with a resilient wrapping or clamp system employing a resilient element of wool felt, neoprene or other suitable material.
- D. Flexible pipe connectors shall be installed between each piece of rotating or reciprocating piece of equipment and the distribution piping system.
- E. Flexible duct connectors shall be installed between each unit containing a fan and the distribution ductwork. Allow at least 1" slack in fabric connectors. Fabric may be attached to ductwork by folding into the sheet metal or attaching with metal flanges.
- F. Flexible duct connectors for kitchen hood exhaust systems shall be slip joint type with high temperature resilient packing material.

END OF SECTION 23 05 48

SECTION 23 05 93 - BALANCING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish all labor, materials and equipment required to test and balance the mechanical systems identified on the contract drawings and these specifications, including but not limited to:
 - 1. Testing, adjustment, and balancing of hydronic, steam, and refrigerating systems.
 - 2. Measurement of final operating condition of HVAC systems.
 - 3. Sound measurement of equipment operating conditions.
 - 4. Vibration measurement of equipment operating conditions.
 - 5. Adjustment of the mechanical systems shall include but not limited to impellers trimmed, new sheeves and belts to match cfm required, etc. as required to match equipment specified.
 - 6. Operating Test

1.3 RELATED SECTIONS

230000 HEATING, VENTILATING AND AIR CONDITIONING INDEX
230100 DEMONSTRATION AND TRAINING
230500 GENERAL HEATING, VENTILATING, AND AIR CONDITIONING
REQUIREMENTS
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
233000 AIR DISTRIBUTION
251000 DIRECT DIGITAL CONTROLS (DDC) SOFTWARE AND COMPONENTS.

1.4 REFERENCES

- A. The publications listed below form a part of these specifications to the extent referenced. Each publication shall be the latest edition of each except as noted.
 - 1. AABC - National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning System.
 - 2. ADC - Test Code for Grilles, Registers, and Diffusers.
 - 3. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
 - 4. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
 - 5. NFPA – NFPA 90A - Installation of Air Conditioning and Ventilating System.
 - 6. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.5 SUBMITTALS

- A. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- B. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.
- C. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.
- D. Provide reports in letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets and indicating thermostat locations.
- E. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
- F. Test Reports: Indicate data on AABC National Standards for Total System Balance forms.
- G. When test and balancing has been completed, the balancing agency shall prepare a complete report including design and test conditions compared. The report shall be as outlined below.
- H. Seven copies of the complete and compiled test data shall be submitted to the Contractor for forwarding to the Architect/Engineer for evaluation and approval.
 - 1. The Report shall be on standard 8-1/2" x 11" good quality paper and bound together to form a complete report. All forms shall be typewritten. Field data may be handwritten on appropriate printed or typewritten forms. Copies of handwritten field notes shall be legible.
 - 2. Each sheet shall have the Building number, name of the Testing Firm, instruments used to perform the tests, name of personnel performing the test, and date test was performed. Date and firm performing the calibration on photometry equipment shall also be included.
 - 3. Outside weather conditions shall be noted during the times the tests were made; cloud cover, temperature, wind speed and direction, precipitation, etc.
- I. The Report shall have a T & B Summary section including:
 - 1. Identification of any system or equipment item the Contractor had difficulty balancing to specification or could not be balanced to specification.
 - 2. Identification of any piece of equipment or system whose balance should be rechecked and/or reset during weather conditions different from those present during system balancing.

1.6 PROJECT RECORD DOCUMENTS

- A. Record actual locations of flow measuring stations balancing valves and rough setting. Show locations on Test and Balance report reduced size plan drawings.

1.7 QUALITY ASSURANCE

- A. Perform total system balance in accordance with NEBB Procedural Standards for Testing, Balancing, and Adjusting of Environmental Systems.

1.8 QUALIFICATIONS

- A. The balancing shall be performed by Energy Balance, Inc., De La Pena LLC, or Kirk Air. Qualified personnel are limited to registered mechanical Engineers and agencies regularly engaged in testing and balancing work. The Contractor shall submit, prior to the start of the balancing work, the qualifications and experience record of the balancing personnel for approval by the Architect/Engineer.
- B. Perform Work under supervision of registered Professional Engineer experienced in performance of this Work and licensed in the state where the Project is located.
- C. The balancing agency shall not be associated with or the same contractor furnishing the controls or instrumentation.

1.9 PRE-BALANCING CONFERENCE

- A. Convene pre-balancing conference one week prior to commencing work of this section in coordination with Architect/Engineer/General Contractor and his Subcontractors.

1.10 SEQUENCING

- A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project. See section 3.1 for pre-balancing inspection.

PART 2 - PRODUCT

2.1 INSTRUMENTS

- A. Instruments in general shall be direct reading. Pressures between 2" W.G. and 12" W.G. shall be measured with manometers. Duct velocities above 600 fpm shall be measured with a pitot tube. Averaging hoods with tight seal shall be used for airflow measurement at diffusers, registers, and grilles. RPM shall be measured with a revolution counter and stopwatch. Mercury thermometers are preferred; bi-metallic thermometers may be used if calibration is checked daily. Test report shall list all instruments used and include accuracy and date calibrated. The Contractor shall provide all instruments to make the tests herein specified and required for complete system balancing.

2.2 AIR HANDLERS

- A. After the air system is balanced and an optimum fan speed is selected, the adjustable sheaf or sheaves furnished shall be replaced by the Mechanical Contractor with new non-adjustable sheaves for permanent operation.

2.3 PUMPS

- A. After the water system is balanced and an optimum pump operating point is selected, the pump impeller shall be trimmed to supply the required capacity for pumps over 2 HP, without throttling the flow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The test and balance agency shall review the plans and specifications prior to installation of the system and submit a report to the Architect/Engineer of any deficiencies in the system which could preclude proper adjusting, balancing, and testing of the system.
- B. The test and balance agency shall inspect the system prior to adjusting, balancing, and testing work to ensure that all specified components which will affect proper execution of such work are installed and are operating properly. A report shall be submitted to the Architect/Engineer indicating the results of the inspection within three days of the inspection. The following is a partial list of items to be inspected and report provided to the Architect/Engineer.
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems and control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire/smoke and volume dampers are in place and open. The smoke detectors and power to them is installed and the dampers are operational. Air coil fins are cleaned and combed.
 - 8. Access doors are closed, and duct end caps are in place.
 - 9. Air outlets are installed and connected.
 - 10. Duct system leakage is minimized.
 - 11. Hydronic systems are flushed, filled, and vented.
 - 12. Pumps are rotating correctly.
 - 13. Proper strainer baskets are clean and in place.
 - 14. Service and balance valves are open.
- C. Submit field reports in a timely manner within one week of pre-balancing conference. Report defects and deficiencies noted during performance of services which prevent system balance.

- D. Beginning of work means acceptance of existing conditions of the installed system and equipment on the project.

3.2 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross-sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

- E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- N. On fan powered VAV boxes, adjust airflow switches for proper operation.

3.6 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.

- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

- 1. HVAC Pumps
- 2. Water Boilers
- 3. Air Cooled Water Chillers
- 4. Packaged Roof Top Heating/Cooling Units
- 5. Packaged Terminal Air Conditioning Units
- 6. Unit Air Conditioners
- 7. Computer Room Air Conditioning Units
- 8. Air Coils
- 9. Terminal Heat Transfer Units
- 10. Air Handling Units
- 11. Fans
- 12. Air Filters
- 13. Air Terminal Units
- 14. Air Inlets and Outlets

B. Report Forms

- 1. Title Page
 - a) Name of Testing, Adjusting, and Balancing Agency
 - b) Address of Testing, Adjusting, and Balancing Agency
 - c) Telephone number of Testing, Adjusting, and Balancing Agency
 - d) Project name
 - e) Project location
 - f) Project Architect
 - g) Project Engineer
 - h) Project Contractor
 - i) Project altitude
 - j) Report date
- 2. Summary Comments
 - a) Design versus final performance
 - b) Notable characteristics of system
 - c) Description of systems operation sequence
 - d) Summary of outdoor and exhaust flows to indicate amount of building pressurization
 - e) Nomenclature used throughout report
 - f) Test conditions, including weather conditions
- 3. Instrument List:
 - a) Instrument
 - b) Manufacturer

- c) Model number
- d) Serial number
- e) Range
- f) Calibration date
- 4. Electric Motors:
 - a) Manufacturer
 - b) Model/Frame
 - c) HP/BHP
 - d) Phase, voltage, amperage; nameplate, actual, no load
 - e) RPM
 - f) Service factor
 - g) Starter size, rating, heater elements
 - h) Sheave Make/Size/Bore
- 5. V-Belt Drive:
 - a) Identification/location
 - b) Required driven RPM
 - c) Driven sheave, diameter and RPM
 - d) Belt, size and quantity
 - e) Motor sheave diameter and RPM
 - f) Center to center distance, maximum, minimum, and actual
- 6. Pump Data:
 - a) Identification/number
 - b) Manufacturer
 - c) Size/model
 - d) Impeller
 - e) Service
 - f) Design flow rate, pressure drop, BHP
 - g) Actual flow rate, pressure drop, BHP
 - h) Discharge pressure
 - i) Suction pressure
 - j) Total operating head pressure
 - k) Shut off, discharge and suction pressures
 - l) Shut off, total head pressure
- 7. Combustion Test:
 - a) Boiler manufacturer
 - b) Model number
 - c) Serial number
 - d) Firing rate
 - e) Overfire draft
 - f) Gas meter timing dial size
 - g) Gas meter time per revolution
 - h) Gas pressure at meter outlet
 - i) Gas flow rate
 - j) Heat input
 - k) Burner manifold gas pressure
 - l) Percent carbon monoxide (CO)
 - m) Percent carbon dioxide (CO₂)
 - n) Percent oxygen (O₂)
 - o) Percent excess air

- p) Flue gas temperature at outlet
 - q) Ambient temperature
 - r) Net stack temperature
 - s) Percent stack loss
 - t) Percent combustion efficiency
 - u) Heat output
8. Gas Fired Equipment
- a) Manufacturer
 - b) Model number
 - c) Serial number
 - d) Firing rate
 - e) Overfire draft
 - f) BTUH at sea level
 - g) BTUH at altitude
 - h) Gas pressure at meter outlet
 - i) Gas flow rate in cfh
 - j) Heat input
 - k) Burner manifold gas pressure
 - l) Orifice size
 - m) Air temperature rise for gas fired equipment
 - n) Check all limit devices for proper operation, setting and calibration
 - o) Make up water pressure setting
 - p) Working pressure
 - q) Ambient temperature
 - r) Relief valve setting
 - s) Static pressure
 - t) Fan hydronic system and fan cfm
 - u) Heat output
9. Air Cooled Condenser:
- a) Identification/number
 - b) Location
 - c) Manufacturer
 - d) Model number
 - e) Serial number
 - f) Entering DB air temperature, design and actual
 - g) Leaving DB air temperature, design and actual
 - h) Number of compressors
10. Chillers:
- a) Identification/number
 - b) Manufacturer
 - c) Capacity
 - d) Model number
 - e) Serial number
 - f) Evaporator entering water temperature, design and actual
 - g) Evaporator leaving water temperature, design and actual
 - h) Evaporator pressure drop, design and actual
 - i) Evaporator water flow rate, design and actual
 - j) Condenser entering water temperature, design and actual
 - k) Condenser pressure drop, design and actual

- l) Condenser water flow rate, design and actual
11. Cooling Coil Data:
 - a) Identification/number
 - b) Location
 - c) Service
 - d) Manufacturer
 - e) Air flow, design and actual
 - f) Entering air DB temperature, design and actual
 - g) Entering air WB temperature, design and actual
 - h) Leaving air DB temperature, design and actual
 - i) Leaving air WB temperature, design and actual
 - j) Water flow, design and actual
 - k) Water pressure drop, design and actual
 - l) Entering water temperature, design and actual
 - m) Leaving water temperature, design and actual
 - n) Saturated suction temperature, design and actual
 - o) Air pressure drop, design and actual
12. Heating Coil Data:
 - a) Identification/number
 - b) Location
 - c) Service
 - d) Manufacturer
 - e) Air flow, design and actual
 - f) Water flow, design and actual
 - g) Water pressure drop, design and actual
 - h) Entering water temperature, design and actual
 - i) Leaving water temperature, design and actual
 - j) Entering air temperature, design and actual
 - k) Leaving air temperature, design and actual
 - l) Air pressure drop, design and actual
13. Air Moving Equipment
 - a) Location
 - b) Manufacturer
 - c) Model number
 - d) Serial number
 - e) Arrangement/Class/Discharge
 - f) Air flow, specified and actual
 - g) Return air flow, specified and actual
 - h) Outside air flow, specified and actual
 - i) Total static pressure (total external), specified and actual
 - j) Inlet pressure
 - k) Discharge pressure
 - l) Sheave Make/Size/Bore
 - m) Number of Belts/Make/Size
 - n) Fan RPM
14. Return Air/Outside Air Data:
 - a) Identification/location
 - b) Design air flow
 - c) Actual air flow

- d) Design return air flow
- e) Actual return air flow
- f) Design outside air flow
- g) Actual outside air flow
- h) Return air temperature
- i) Outside air temperature
- j) Required mixed air temperature
- k) Actual mixed air temperature
- l) Design outside/return air ratio
- m) Actual outside/return air ratio
- 15. Exhaust Fan Data:
 - a) Location
 - b) Manufacturer
 - c) Model number
 - d) Serial number
 - e) Air flow, specified and actual
 - f) Total static pressure (total external), specified and actual
 - g) Inlet pressure
 - h) Discharge pressure
 - i) Sheave Make/Size/Bore
 - j) Number of Belts/Make/Size
 - k) Fan RPM
- 16. Duct Traverse:
 - a) System zone/branch
 - b) Duct size
 - c) Area
 - d) Design velocity
 - e) Design air flow
 - f) Test velocity
 - g) Test air flow
 - h) Duct static pressure
 - i) Air temperature
 - j) Air correction factor
- 17. Duct Leak Test:
 - a) Description of ductwork under test
 - b) Duct design operating pressure
 - c) Duct design test static pressure
 - d) Duct capacity, air flow
 - e) Maximum allowable leakage duct capacity times leak factor
 - f) Test apparatus
 - 1) Blower
 - 2) Orifice, tube size
 - 3) Orifice size
 - 4) Calibrated
 - g) Test static pressure
 - h) Test orifice differential pressure
 - i) Leakage
- 18. Air Monitoring Station Data:
 - a) Identification/location

- b) System
 - c) Size
 - d) Area
 - e) Design velocity
 - f) Design air flow
 - g) Test velocity
 - h) Test air flow
19. Flow Measuring Station:
- a) Identification/number
 - b) Location
 - c) Size
 - d) Manufacturer
 - e) Model number
 - f) Serial number
 - g) Design Flow rate
 - h) Design pressure drop
 - i) Actual/final pressure drop
 - j) Actual/final flow rate
 - k) Station calibrated setting
20. Terminal Unit Data:
- a) Manufacturer
 - b) Type, constant, variable, single, dual duct
 - c) Identification/number
 - d) Location
 - e) Model number
 - f) Size
 - g) Minimum static pressure
 - h) Minimum design air flow
 - i) Maximum design air flow
 - j) Maximum actual air flow
 - k) Inlet static pressure
21. Air Distribution Test Sheet:
- a) Air terminal number
 - b) Room number/location
 - c) Terminal type
 - d) Terminal size
 - e) Area factor
 - f) Design velocity
 - g) Design air flow
 - h) Test (final) velocity
 - i) Test (final) air flow
 - j) Percent of design air flow
22. Sound Level Report:
- a) Location
 - b) Octave bands - equipment off
 - c) Octave bands - equipment on
23. Vibration Test:
- a) Location of points:
 - 1) Fan bearing, drive end

- 2) Fan bearing, opposite end
 - 3) Motor bearing, center (if applicable)
 - 4) Motor bearing, drive end
 - 5) Motor bearing, opposite end
 - 6) Casing (bottom or top)
 - 7) Duct after flexible connection (discharge)
 - 8) Duct after flexible connection (suction)
- b) Test readings:
- 1) Horizontal, velocity and displacement
 - 2) Vertical, velocity and displacement
 - 3) Axial, velocity, and displacement
- c) Normally acceptable readings, velocity, and acceleration
- d) Unusual conditions at time of test
- e) Vibration source (if non-complying)

3.8 CALCULATIONS

- A. The following calculations shall be made and become part of the reported data.
1. The CFM at each heating, cooling, and fan coil, the heating and/or cooling capacity of each and the air temperature change of each.
 2. The water flow at each heating, cooling, and fan coil, the heating and/or cooling capacity of each and the water temperature change of each.
 3. The fuel flow to each gas fired unit and the BTUH input.
 4. The capacity of each refrigeration unit in BTUH or tons at full capacity and at each unloaded step.

3.9 OPERATING TEST

- A. The test and balance agency shall coordinate and set up an operating test when Test & Balance is completed to ensure complete operation of the system in all modes. The controls contractor, sheet metal trade and the general contractor shall certify in writing test completion and all units are operating as designed. Attach copy of operating test to Test & Balance report.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and Install
 - 1. Ductwork insulation.
 - 2. Duct liner.
 - 3. Insulation jackets.

1.2 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section

1.3 DESCRIPTION OF WORK

- A. Work Included: The work included by this specification consists of furnishing all labor, accessories, equipment, and materials necessary for the installation of all insulation for ductwork and mechanical equipment in accordance with the specification and applicable drawings. This includes but is not limited to:
 - 1. All supply ductwork
 - 2. Return ductwork not within the conditioned space
 - 3. All ductwork in the mechanical room
 - 4. Outside air inlet ductwork that is within the conditioned space.
 - 5. Mechanical equipment not factory insulated.
- B. Do not internally insulate ductwork from evaporative coolers unless specifically indicated on the drawings.
- C. Exterior duct wrap insulation with vapor barrier shall be used on all outdoor air ductwork within conditioned spaces.
- D. Supply and return air ductwork shall be insulated with duct liner except in air handling systems having air washers or humidifiers. Where air washers or humidifiers are used, exterior duct insulation shall be used. Where duct liner is used, dimensions shown on the drawings shall be clear inside duct liner.
- E. Testing:
 - 1. All ductwork and mechanical equipment shall be tested for leakage and approved by the Architect/Engineer before any insulation is applied. The insulation contractor shall have this verified in writing before beginning work.

1.4 RELATED WORK IN OTHER SECTIONS

099000 PAINTING: PAINTING INSULATION JACKETS.
230000 HEATING, VENTILATING, AND AIR CONDITIONING INDEX
230500 GENERAL HEATING, VENTILATING, AND AIR CONDITIONING
REQUIREMENTS
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
233000 AIR DISTRIBUTION

1.5 REFERENCES

- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- C. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
- D. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- E. ASTM E84 - Surface Burning Characteristics of Building Materials.
- F. ASTM E96 - Water Vapor Transmission of Materials.
- G. NFPA 255 - Surface Burning Characteristics of Building Materials.
- H. SMACNA - HVAC Duct Construction Standards 1985 Ed. - Metal and Flexible.
- I. UL 723 - Surface Burning Characteristics of Building Materials

1.6 DEFINITIONS

- A. Exposed Location: Exposed in mechanical rooms or rooms with finished walls or ceilings.
- B. Concealed Location: Located in pipe chase, furred spaces, attics, crawl spaces, above suspended ceilings in finished and unfinished rooms, or all other locations not exposed to view.
- C. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- D. K Factors: All K Factors shown in the following specifications are expressed in BTU-in/hr-sq.ft-F.

1.7 SUBMITTALS

- A. General: Comply with Section 230500.

- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
- C. Manufacturer's Installation Instructions: Indicate procedures, which ensure acceptable workmanship and installation standards will be achieved.

1.8 QUALITY ASSURANCE

- A. Regulatory Requirements Fire Hazard Classification: Insulation shall have a composite (insulation, jacket or facing, and adhesive to secure jacket or facing) fire hazard rating as tested by ASTM E84, NFPA 255, or UL 723 not to exceed 25 flame spread, 50 fuel contribution, and 50 smoke development. Materials shall be labeled accordingly.
- B. Certifications of Insulation and Covering Materials: UL listed; flame spread/fuel contributed/smoke development rating of 25/50 in accordance with ASTM E84, NFPA 255, and UL 723.

1.9 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section with minimum five years of documented experience.

1.10 DELIVERY, STORAGE AND HANDLING

- A. General Requirements: Comply with Section 230500. Deliver materials to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness. Store in a warm, dry location and protect against dirt, water, chemical, and mechanical damage.

1.11 PROJECT CONDITIONS

- A. Manufacturer's Requirements: Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation while in storage.
- B. Environmental Requirements: Perform work at ambient and equipment temperatures as recommended by the insulation manufacturer.
- C. Protection: Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Repair or replace any such insulation or covering damaged prior to final acceptance of work.

1.12 WARRANTY

- A. General: Satisfy requirements of Section 230500.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
1. Owens-Corning Fiberglass Corporation.
 2. Knauf.
 3. Certainteed.
 4. Manville.

2.2 INSULATION MATERIALS

- A. Glass Fiber, Flexible:
1. Insulation: ASTM C-553; flexible, noncombustible blanket.
 - a) 'K' value: ASTM C518, of 0.29 at 75 degrees F.
 - b) Maximum service temperature: 250 degrees F.
 - c) Maximum moisture absorption: 0.20 percent by volume.
 - d) Density: 0.75 lb/cu ft.
 2. Vapor Barrier Tape:
 - a) Kraft paper reinforced with glass fiber yarn and bonded to aluminum film.
 3. Tie Wire: Annealed steel, 16-gage.
- B. Glass Fiber, Rigid:
1. Insulation: ASTM C612; rigid, noncombustible blanket.
 - a) 'K' value: ASTM C518, of 0.29 at 75 degrees F.
 - b) Maximum service temperature: 250 degrees F.
 - c) Maximum moisture absorption: 0.20 percent by volume.
 - d) Density: 0.75 lb/cu ft.
 2. Vapor Barrier Jacket:
 - a) Kraft paper reinforced with glass fiber yarn and bonded to aluminum film.
 - b) Moisture vapor Transmission: ASTM E96; 0.04 perm.
 - c) Secure with pressure sensitive tape.
 3. Vapor Barrier Tape:
 - a) Kraft paper reinforced with glass fiber yarn and bonded to aluminum film, with pressure sensitive rubber-based adhesive.
- C. Glass Fiber Duct Liner, Flexible
1. Insulation: ASTM C-553; flexible, noncombustible blanket.
 - a) 'K' value: ASTM C518, of 0.28 at 75 degrees F.
 - b) Maximum service temperature: 250 degrees F.
 - c) Density: 2.0 lb/cu ft.
 - d) Maximum Velocity on Coated Air Side: 4000 ft/min.
 2. Adhesive

- a) Waterproof, fire-retardant type.
3. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

D. Glass Fiber Duct Liner, Rigid:

1. Insulation: ASTM C-612; flexible, noncombustible.
 - a) 'K' value: ASTM C518, of 0.23 at 75 degrees F.
 - b) Maximum service temperature: 250 degrees F.
 - c) Density: 2.0 lb/cu ft.
 - d) Maximum Velocity on Coated Air Side: 4000 ft/min.
2. Adhesive:
 - a) Waterproof, fire-retardant, type.
3. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

2.3 JACKETS

A. Canvas Jackets: UL listed.

1. Fabric: 6 oz/sq yd, plain weave cotton treated with dilute fire-retardant lagging adhesive.
2. Lagging Adhesive: Compatible with insulation.

B. Aluminum Jacket: ASTM B209.

1. Thickness: 0.025-inch sheet.
2. Finish: Smooth or Corrugated.
3. Joining: Longitudinal slip joints and 2-inch laps.
4. Fittings: 0.016-inch-thick die shaped fittings covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8-inch wide, 0.016-inch-thick aluminum.
6. Flexible glass fiber with fire resistant coating facing air stream; ASTM E-84/ASTM C518-70; 'k' value of 0.25 maximum at 75 F, 2 lb. density, one-inch thickness.

C. Type C: Neoprene faced, rigid glass fiberboard, 2 lb. density, ASTM E- 84/ASTM C-518; 'k' value of 0.23 at 75 F; one-inch thickness.

D. Jackets:

1. Interior Applications
 - a) Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.
2. Exterior Applications
 - a) Sheet metal enclosure of corrugated aluminum, 0.02 in. thick, with metal jacket bands: 3/8 inch wide, 0.016 thick aluminum; or stick clips with smooth finish.

2.4 ACCESSORIES

- A. Impale Anchors: Galvanized steel, 12-gage, self-adhesive pad and press on washer head.
- B. Joint Tape: Glass fiber cloth, open mesh.
- C. Lagging Adhesive: Fire resistive to ASTM E-84 or NFPA 255 or UL 723.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that ductwork has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. General

1. Applications: Apply insulation tightly over clean, dry surfaces with sections or edges firmly butted together or lapped. Make insulation continuous through sleeves or openings in walls or floors.
2. Vapor Barriers: Seal vapor barriers and run continuous throughout for heated and cooled supply air ductwork.
3. Finishes: Finish insulation neatly at hangers, supports and other protrusions. Locate insulation or cover seams in least visible locations.
4. Installation Repairs: Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.
5. Exterior Locations: Re-cover with corrugated aluminum jacket attached with suitable aluminum rivets.
6. Manufacturer's Instructions: Install materials in accordance with manufacturer's instructions.
7. Thermal Units: Provide insulation with vapor barrier on ductwork downstream of fan coil terminal units.
8. Factory Insulated Equipment: Do not insulate factory-insulated equipment.
9. Attachment: Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
10. Cement and Fillers: Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
11. Placards: Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such nameplate or any operable device.
12. Service Access: When equipment with insulation requires periodical opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.
13. Insulation shall be installed in a workmanlike manner by workmen regularly engaged in this type of work. Insulation shall not be applied until all surfaces are clean and dry and until inspection and release for insulation application.

14. A complete moisture and vapor seal shall be provided on cold surfaces where vapor barrier jackets or coatings are required. Anchors, hangers, and other projections shall be insulated, and vapor sealed to prevent condensation.
15. Duct insulation shall be continuous through walls and floor openings except where walls or floors are required to be fire stopped or required to have a fire resistance ratings.

B. Locations for Insulation:

1. External: Outside of ducts not internally lined, located interior of building, in mechanical room.
 - a) Rectangular: 1-1/2-inch-thick glass fiber insulation. Fasten to duct with weld pins or stock clips spaced 12 inches to 18 inches o.c. with minimum of two rows per side of duct. Secure with washers firmly embedded in insulation. Seal joints, breaks, and punctures in cold air ductwork with fire-retardant vapor adhesive reinforced with a three-inch wide strip similar to that of facing.
 - b) Round: Two-inches thick glass fiber blanket duct wrap. Adhere insulation to duct with fire retardant adhesive applied in bands around the duct. Butt tight with facing overlapping all joints at least two inches. Seal cold air ductwork with fire retardant vapor barrier adhesive. Seal breaks and punctures in the facing of cold air ductwork with vapor barrier tape sealed with fire retardant adhesive.
2. For exterior applications, provide insulation with vapor barrier jacket w/2" thick rigid insulation w/minimum R-value of 8. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
3. Insulation below grade shall be polyurethane spray foam, suitable for use in wet environments without degradation and having the following properties.
 - a) All duct shall be supported on 2" thick rigid polystyrene board exceeding the width of the duct. Spray foam shall be applied to assure a 2" MINIMUM coverage. Insulation shall be coated with Deer-O Foam Cap W-256 applied at the rate of one gallon per 100 square ft. for vapor barrier protection with a perm rating of 0.00019.

C. Duct Liner

1. Duct liner shall be installed in accordance with Figures 6-1 through 607 of the SMACNA High Velocity Duct Manual and the Manufacturer's recommendations.

END OF SECTION 23 07 13

SECTION 23 21 13 - HYDRONIC PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. The Contractor shall furnish and install the Hydronic Piping Systems for heating hot water and chilled water as shown on the drawings including specialties shown or called out in the equipment list and as necessary for satisfactory operation of the system.

1.3 RELATED WORK IN OTHER SECTIONS

220523 VALVES
220700 PIPING INSULATION
221000 PIPE AND PIPE FITTINGS
230000 HEATING, VENTILATING, AND AIR CONDITIONING INDEX
230500 GENERAL HEATING, VENTILATING, AND AIR CONDITIONING
REQUIREMENTS
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230519 PIPING SPECIALTIES
230548 VIBRATION ISOLATION AND EXPANSION COMPENSATION
230593 BALANCING OF MECHANICAL SYSTEMS

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Pipe and pipefittings shall be as described in Section 221000 - PIPE AND PIPE FITTINGS.

2.2 VALVES

- A. Valves other than automatic control valves shall be provided as shown or required to protect the system and are specified in Section 220523 - VALVES.
- B. Automatic control valves are specified in Section 253000 - CONTROLS AND INSTRUMENTATION.

2.3 COILS

- A. Water coils are as specified on the Mechanical Equipment Schedule on the drawings.
- B. Water coils shall be provided with a manual air vent located in the system piping, in addition to the one provided with the coil in order to purge any trapped air from the coil and associated piping.

2.4 PUMPS

- A. Pumps shall be of the type and capacity listed in the equipment schedule and shall be furnished with open drip proof motors. Pumps shall be selected so that the motors will not overload under any possible operating condition including open discharge. Furnish one spare mechanical seal for each pump. All pumps shall have drain pans with tapped pipe connections and 3/4-inch drain line extended to floor drain. Pumps shall be installed so that they may be removed without the removal of the associated piping. All pump strainers shall be provided with blow off valves and lines full size extended to floor drain.

2.5 EXPANSION TANKS

- A. Expansion tanks shall be as scheduled on the drawings. Expansion tanks in antifreeze-protected systems shall be constructed and labeled for service in antifreeze-protected systems.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Piping installation shall conform to the requirements of Section 221000 - PIPE AND PIPE FITTINGS.
- B. Installation of specialties shall conform to the requirements of Section 230519 - PIPING SPECIALTIES.

3.2 TESTS

- A. All piping shall be proved tight at a hydrostatic pressure of 150 psi and show no loss in pressure for a period of one hour.

END OF SECTION 23 21 13

SECTION 23 25 00 - WATER TREATMENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. The Contractor shall provide all labor, material, equipment, design detail and layout required to provide complete water treatment systems indicated in these specifications. The Contractor shall coordinate installation of the water treatment system(s) with the trades involved in constructing other systems. The contractor shall furnish all piping, valves, equipment, meters, probes, tanks, pumps, controls, wiring, etc., for the water treatment system. The water treatment contractor shall coordinate location of required electrical receptacles with electrical contractor and piping instrument taps or wells with the piping contractor and obtain final approval from Architect/Engineer, with any additional cost incurred by this contractor. The Contractor shall not hold the Owner liable for any lack of coordination.

1.3 RELATED WORK IN OTHER SECTIONS

220700 PIPING INSULATION
221000 PIPE AND PIPE FITTINGS
230000 HEATING, VENTILATING, AND AIR CONDITIONING INDEX
230100 DEMONSTRATION AND TRAINING
230500 GENERAL HEATING, VENTILATING, AND AIR CONDITIONING
REQUIREMENTS
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

1.4 GENERAL

- A. All systems and components shall be furnished and installed by one Contractor. The contractor shall have a minimum of five (5) years experience in design and installation of water treatment systems. The Architect/Engineer may reject any proposed installer who cannot show evidence of such qualifications.
- B. The system components and information herein are intended to establish standards of performance, quality, and construction.

1.5 SUBMITTALS

- A. In addition to submittals required under GENERAL PROVISIONS the contractor shall furnish a 1/8" scale (minimum) room floor plan indicating location and connection points of all equipment to be installed.

PART 2 - PRODUCTS

2.1 WATER TREATMENT - SYSTEM(S)

A. Hot Water Boiler:

1. Provide a boiler water treatment system for the hot water boiler(s) to inject controlled amounts of non-chromate chemicals into the boiler(s) as required to prevent scaling and corrosion of the closed loop system.
2. The Contractor shall provide all necessary chemicals and service for one year. The Contractor shall provide the Owner with written reports, analysis, and recommendations on a monthly basis during the year with weekly reports when the boiler is in operation.
3. The equipment shall consist of a by-pass feeder similar to Neptune Chemical Pump Company VTF or approved equal. The quantity of the chemical shall be determined by a qualified water treatment chemist for each type of installation.
4. Provide a ball or gate valve and a check valve at each connection. Connecting tube may be plastic or copper as preferred by the Contractor and approved by Code for the location where installed.
5. The chemical shall be formulated by a water treatment chemist to prevent scale formation in the boiler and any foaming in the boiler. A oxygen scavenger shall be included.

B. Chilled water systems shall be provided with the same water treatment system as boiler system as boiler system except treatment shall be for chilled water system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the system(s) completely. After the equipment and piping system have been installed and cleaned thoroughly and are ready to be filled, the treatment contractor shall provide the necessary treatment, for the fill of all piping and related equipment. The contractor shall be present at initial fill of the system(s).
- B. After operation of several hours, the treatment level in all systems shall be checked and adjusted to the proper level.
- C. After operation for several days, the treatment level of all systems shall be checked and adjusted. Repeat in 30 days.
- D. The installer shall be responsible for adjusting the proper amounts of chemicals on a monthly basis for the first year.
- E. Instruct the owner in proper methods of testing and adjusting the water treatment equipment and chemicals.

END OF SECTION 23 25 00

SECTION 23 30 00 - AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install fans, filters, sheet metal work, grilles, louvers, diffusers, registers, sound traps, special fan bases, fire dampers, combination fire and smoke dampers and sleeves, accessories and natural gas fired appliance flue vents.
- B. All automatically controlled dampers furnished under Section 253000 - CONTROLS AND INSTRUMENTATION will be installed under this section. After dampers are set, they shall be balanced for free and easy operation.
- C. Where ductwork has an interior lining, dimensions shown on drawings shall be clear dimensions inside the liner.
- D. Prior to system test and balance, supply and install new, clean air filters throughout the air handling systems except for any high efficiency filters, which have pressure drop within normal operating limits.

1.3 REQUIREMENTS AND RELATED WORK

230000 HEATING, VENTILATING, AND AIR CONDITIONING INDEX
230500 GENERAL HEATING, VENTILATING, AND AIR CONDITIONING
REQUIREMENTS
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230593 BALANCING OF MECHANICAL SYSTEMS
230713 DUCT INSULATION
253000 CONTROLS AND INSTRUMENTATION

1.4 REFERENCES

- A. ASTM A 36 - Structural Steel
- B. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
- C. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- D. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality
- E. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

- F. ASTM A 525 - General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process
- G. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality
- H. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled
- I. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality
- J. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate
- K. AWS D9.1 - Welding of Sheet Metal
- L. NFPA 90A - Installation of Air Conditioning and Ventilating Systems - Latest Edition
- M. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems -Latest Edition.
- N. NFPA 91 - Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying - Latest Edition
- O. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment - Latest Edition
- P. SMACNA - HVAC Air Duct Leakage Test Manual
- Q. SMACNA - HVAC Duct Construction Standards - Metal and Flexible – 1985
- R. UL STANDARD 181 - Factory-Made Air Ducts and Connectors
- S. UL STANDARD 555 – Standard for Safety Fire Dampers
- T. UL STANDARD 555S – Leakage Rated Dampers for use in Smoke Control Systems

PART 2 - PRODUCTS

2.1 EQUIPMENT SCHEDULES

- A. All major items of equipment are specified in the equipment schedule on the drawings and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory operating system.

- B. All registers, grilles and diffusers shall be as listed in the schedule on the drawings. Frame style shall be coordinated by the Contractor to match the ceiling type shown on the reflected ceiling plans of the Contract Documents.

2.2 DUCTWORK

A. Sheet Metal

1. Materials and Gauges: Construct all ducts, casings, plenums, etc., of galvanized steel sheets, of the gauges specified below, unless otherwise shown. Sheets shall be free from blisters, slivers, pits, and imperfectly galvanized spots.
 2. All ductwork shall be constructed in accordance with "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE". First Edition, 1985 as published by Sheet Metal and Air Conditioning Contractors National Association, Inc. Pressure class for all ductwork shall be 2" or unless otherwise noted on plans.
 3. Construct low velocity ducts using Pittsburgh or "Snap-Lock" corner seams. All seams shall be made airtight. Using United Mc Grill "UNI-FLEX" duct sealer or approved equal.
 4. Connections of high pressure and/or velocity ducts, fittings and high-pressure boxes shall be made airtight by tack welding on 8" centers and coating joints with United Mc Grill "United duct Sealer".
 5. Round ducts and fittings for high velocity systems shall be spiral lock seam conduit as manufactured by United Mc Grill Co., Inc., or approved equal. All 90 elbows shall be at least 5-piece construction. Standard manufactured ducts of other than spiral construction will be acceptable if constructed of the following gauges with welded seams. Sizes thru 12-inch diameter shall be 22-gauge, 13-inch thru 36-inch diameter shall be 20-gauge, 37 inches and over shall be 18-gauge. Basic high velocity fittings are detailed on the drawings. Spun or tapered takeoffs shall be used from all vertical high velocity risers.
- B. Construct T's, bends, and elbows with radius of not less than 1-1/2 time's width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
 - C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible, maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
 - D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4-inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
 - E. Provide standard 45-degree lateral wye takeoffs unless otherwise indicated where 90-degree conical tee connections may be used.
 - F. Flexible

1. Flexible ducts for connections between rigid ductwork and variable volume boxes shall be Factory Insulated flexible conduit capable of holding 5 inches W.C. without development leaks and shall not exceed a flame spread of 25 or a smoke development of 50. Thermo flex Type N-KH or approved equal.
2. Flexible connections between the diffusers and the run out ducts shall be factory insulated, sound absorbing low velocity flexible conduit conforming to the following duct fabrication shall not exceed a flame spread of 25 or a smoke development of 50.
 - a) Two ply vinyl film supported by helically wound spring steel wire: fiberglass insulation: polyethylene vapor barrier film.
 - b) Pressure Rating: 10 inches WG (2.50 kPa) positive and 1.0 inches WG (250 Pa) negative.
 - c) Maximum Velocity: 4000 fpm (20.3 m/sec).
 - d) Temperature Range: -10 degrees F to 160 degrees F (-23 degrees C to 71 degrees C).

2.3 COMBINATION FIRE/SMOKE DAMPERS

- A. Furnish and install at locations shown on plans, or as required by code combination fire/smoke dampers meeting the following specifications. Frame shall be galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement.
- B. Each combination fire smoke damper shall be 1-1/2-hour fire rated under UL Standard 555 or greater where noted on architectural plans and bear a UL label attesting to same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. The leakage rating under UL555S shall be Leakage Class II (10 cfm/ft. at 1" w.g.)
- C. In addition to the leakage ratings already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 250° F, 350°F, or 450°F depending upon the actuator. Appropriate electric "Firestat" operator shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity which meets all applicable UL555 and UL555S qualifications for both dampers and actuators. Manufacturer shall provide factory assembled sleeve of 16" minimum length (contractor to verify requirement). Factory supplied caulked sleeve shall be 16-gage for dampers up to 36" wide by 24" tall and 14-gage above 36" wide X 24" tall.
 1. Combination Fire/Smoke dampers shall be Ruskin FSD6O rectangular dampers and Ruskin FSDR25 for round dampers or approved equal with correct mounting frames and sleeves for actual installation.
 2. Combination Fire/Smoke dampers for corridors ceiling shall be Ruskin FSD36 with internally mounted actuator.
- D. Each combination fire and smoke damper shall include an integral factory furnished and installed duct smoke detector compatible with the building fire alarm system. Assembly by Ruskin DSDN or approved equal.
- E. Size of access doors in ductwork shall be 2 inches less than the width of the duct by 12 inches, up to a maximum size of 24 inches by 24 inches.

2.4 FIRE DAMPERS

- A. Furnish and install at locations shown on the drawings or as required by code fire dampers meeting the following requirements. Provide access doors at all fire damper locations of sufficient size to allow easy resetting of fire damper linkage. Fire damper links shall be of the test strength recommended to prevent nuisance closing. All fire dampers shall conform to the requirements of NFPA Pamphlet 90A and shall meet the required UL Standard 555.
- B. High Velocity Round or Oval Fire Dampers: High velocity fire dampers shall be of the folding blade type designed for minimum static pressure drop. Fusible links shall be accessible from either side of the damper. Each damper shall be furnished complete with a galvanized welded steel sleeve (round or oval) and closure compartment to house the folded blades. Fire dampers shall be Ruskin FD35 with 165°F fusible link or approved equal.
- C. Rectangular Fire Dampers: Fire dampers for rectangular ductwork shall be of the folding blade type with the hinged blades completely out of the air stream of the single hinged blade type. Fusible links shall be accessible from either side of the damper. Each damper shall have a galvanized welded steel sleeve (rectangular or square) and closure compartment to house the folded blades. Rectangular fire dampers mounted in the horizontal plane are to be spring loaded. Fire dampers shall be Ruskin DIBD with 165°F fusible link or approved equal.
- D. Provide access doors at all fire damper locations of sufficient size to allow easy resetting of fire damper linkage. Size of access doors in ductwork shall be 2 inches less than the width of the duct by 12 inches, up to a maximum size of 24 inches by 24 inches.
- E. Each fire damper shall be provided with spare fusible link(s) secured to the damper.

2.5 ACCESS DOORS

- A. Wall and Ceiling Access Doors: Furnish as required in Section 230500, paragraph 3.6.
- B. Duct Access Doors: Duct access doors at fire dampers and other locations which require access to mechanical devices inside of ductwork shall be Controlair 16-gauge access door with continuous hinge, neoprene gasket, thumb screw locks and baked enamel finish. Doors shall be sized for easy access to mechanical device.
- C. Doorframes on insulated ductwork shall be placed on an extended metal collar flush with the face of the finished insulation.
- D. Latches shall be operable from either side of door and shall be "Ventlok" No. 310.

2.6 FILTERS

- A. Filters shall be as listed in the schedule on the drawings.

- B. Filter gauge for each bank of filters in the mechanical rooms and roof top equipment will be supplied and installed by the Controls Contractor as specified in Section 253000 - CONTROLS AND INSTRUMENTATION.

2.7 COILS

- A. In no case shall specified air or water pressure drops be exceeded more than 10%. Piping connections shall be as shown on the drawings. Coils shall be as specified in the equipment schedule on the drawings. In no case shall rows or fin spacing be less than the minimum surface scheduled.

2.8 TURNING VANES

- A. Turning vanes shall be installed in all square elbows. Turning Vanes shall be air foil blade type, shop or factory fabricated.

2.9 FLUE GAS VENTS

- A. Gas fired equipment shall be vented in accordance with the Uniform Mechanical Code, Uniform Plumbing Code and local codes and ordinances. Natural draft appliances shall have Type "B" vents.

PART 3 - EXECUTION

3.1 INSTALLATION OF SHEET METAL WORK

- A. All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary the required area shall be maintained. All of these changes, however, must be approved and installed as directed at the project. During the installation, the open ends of ducts shall be protected to prevent debris and dirt from entering. Whenever exposed ducts pass through walls, floors or ceilings, a flanged sheet metal collar fitting close around ducts shall be slipped along duct until flange is tight against finished surface covering edges of openings and presenting a neat appearance. Collar shall be locked to duct.
- B. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- C. Use double nuts and lock washers on threaded rod supports.
- D. Connect diffusers or light troffer boots to low-pressure ducts with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.
- E. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- F. Encase buried metal ductwork in 3-inch minimum of concrete. Provide adequate tie-down points to prevent ducts from floating during concrete placement. Introduce no heat into ducts for 20 days following placement of concrete.

- G. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- H. All ducts, coils, housings, registers, grilles, fans, etc., shall be clean when installed and shall be kept clean until the system is completed. As the various parts of the system are installed, they shall be wiped or blown clean and openings taped dust-tight with heavy paper or cardboard until the system is completed and ready for testing. At that time all covers and protective wrappings shall be removed. Where one has been torn or previously removed, the duct, coil, register, etc., shall be carefully cleaned of any dirt or dust that has entered the opening.

3.2 DUCTS AT MASONRY

- A. Where ducts are shown connecting to masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2" x 1/8" galvanized angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron.

3.3 HAND AND SPLITTER DAMPERS

- A. Install hand operated volume and splitter dampers at all locations of branches of main ducts, from equipment, supply ducts, return ducts and at all locations where air flow splits or is balanced, whether shown or not. Volume dampers shall be controlled by heavy duty locking quadrants mounted on the outside of the duct. Where ducts are insulated the damper rod shall be extended and the operator shall be mounted on the outside of the insulation. Where volume dampers are installed in ducts over 12" deep, the dampers shall be made in two sections and each independently operated. Splitter dampers shall be at least 1 1/2 times as long as the narrowest adjacent split. All damper fittings must be heavy commercial items and must be approved by the Architect/Engineer before installation.

3.4 FLEXIBLE CONNECTIONS

- A. Provide glass fabric, neoprene coated flexible connections, not less than 6" wide at the inlet and outlet connection of each fan unit, securely fastened to the unit and to the ductwork. Material shall comply with Underwriter's Laboratories Standard 214.
- B. Indoor applications shall have Metaledge Ventglas with heavy glass fabric, double coated with Dupont's Neoprene.
- C. Outdoor applications shall have Metaledge Ventlon with heavy glass fabric, double coated with Dupont's Hypalon.

3.5 CROSS BREAKING

- A. Rectangular sheet metal ducts shall be cross-broken on the four sides of each 4-foot panel. All vertical and horizontal sheet metal barriers, duct offsets, elbows, as well as 4-foot panels of straight sections of ducts shall be cross-broken. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles. The center

of the cross break shall be of the required height to assure surfaces being rigid. High velocity plenum panels and ductwork shall not be cross broken.

3.6 TEST HOLES IN DUCTWORK

- A. Furnish test holes in ducts at locations required by the testing and balancing team for testing of air quantities in ducts. Ventlok No. 699, closures shall be provided and installed for each test hole, with sufficient neck length to penetrate the insulation.

3.7 HANGERS AND SUPPORTS

- A. Hangers for ducts up to 18 inches in width or diameter shall be placed not more than ten-foot centers. Ducts 19 inches and over in width or diameter shall be supported on not more than five-foot centers. Hangers shall be placed plumb and present for a neat appearance. Construct hangers for high velocity boxes and for ductwork form galvanized iron 1" x 1" x 1/16" for ducts up to 36 inches in width or diameter. For ducts over 36 inches in width or diameter, support ducts every 4'-0" with 1 1/4" x 1 1/2" x 1/8" angles. The use of perforated band iron for duct support is prohibited. Hangers shall extend down the sides of the ducts using not less than three rivets or parker screws of appropriate sizes. It is essential that all ducts be rigidly supported. Where vertical ducts pass thru floors or roofs heavy supporting angles shall be attached to ducts and to the structure. Angles shall be of sufficient size to support ductwork rigidly. Place supporting angles on at least two sides of the duct.

3.8 FABRICATION

- A. All ductwork shall be fabricated with the mill markings on the outside.

3.9 TESTS

- A. Testing and balancing of the air tempering systems will be as specified in Section 230593 - BALANCING OF MECHANICAL SYSTEMS.
- B. If specified conditions cannot be obtained due to deficiencies in equipment performance or improper installation or workmanship, the Mechanical Contractor shall make any changes necessary to provide the specified conditions.
- C. Cleaning ducts and testing for tightness: Before the ceiling is installed and final connections are made to air outlet devices, operate the fans at full capacity to blow out dirt and debris from the ducts. If it is not practical to use the main supply blower for cleaning, the ducts may be blown out in sections by a portable fan. After the ducts have been cleaned, an air tightness test shall be made on all ductwork. A minimum pressure equal to fan static pressure at less than 10% of design flow or 2 1/2 times design external static pressure, whichever is less shall be maintained during the test. A soap test shall be applied to all sheet metal connections and joints to locate air leaks. Air leaks which are in excess of that required to bubble the soap suds (that is, actually blow the suds away), shall be sealed by additional taping and caulking to reduce the leakage to a rate not to exceed slow bubbles forming. In lieu of the above tightness tests, the Contractor may test the ducts by attaching a fan with a capacity of not over 300 cfm at 2 1/2" static pressure to the ductwork and with outlets blocked airtight, build up the pressure in the ducts to 2"

water gauge. If this pressure cannot be obtained the Contractor shall locate and repair the leaks as specified above. The Architect/Engineer and Owner's Representative shall witness the test and the Contractor shall notify the Insulation Contractor in writing when the test has been satisfactorily completed.

END OF SECTION 23 30 00

SECTION 23 62 00 - AIR COOLED CHILLER

PART 1 - GENERAL

1.1 SCOPE

- A. The contractor is to remove the existing air-cooled chiller complete with all associated controls, piping, supports, electrical and accessories as required to allow the new installation.
- B. The contractor is to install a new air-cooled chiller complete with all piping, valves, controls, supports, electrical and accessories as required for a complete operational assembly.

1.2 CHILLER DESCRIPTION

- A. Microprocessor controlled air-cooled liquid chiller utilizing reciprocating compressors and thermal expansion valves.

1.3 QUALITY ASSURANCE

- A. Unit shall be rated in accordance with ARI Standard 590, latest edition.
- B. Unit construction shall comply with ANSI B9.1 Safety Code, NEC and ASME applicable codes.
- C. Unit cabinet shall be capable of withstanding Federal Test Method Standard No. 141 (method 6061) 500-hour salt spray test.
- D. Cooler shall be tested and stamped in accordance with ASME Code for a refrigerant working side pressure of 235 psig and a minimum water side pressure of 150 psig.
- E. Air-cooled condenser coils shall be leak tested at 150 psig and pressure at 450 psig.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. General: Factory assembled, single piece, air-cooled liquid chiller. Contained within the unit cabinet shall be all factory wiring, piping, controls, refrigerant charge (R-22) and special features required prior to field start-up.
- B. Unit Cabinet: Galvanized steel casing, zinc phosphatized, with an electrostatically applied baked enamel finish.
- C. Fans: Condenser fans shall be direct-driven propeller type discharging air vertically upward.
 - 1. Equipped with permanently lubricated bearings.
 - 2. Equipped with PVC coated steel wire safety guards.

3. Shafts shall have inherent corrosion resistance.
 4. Statically and dynamically balanced.
- D. Compressors:
1. Reciprocating semi-hermetic type only.
 2. Each equipped with an automatically reversible oil pump, operating oil charge, suction and discharge shutoff valves, and an insert-type factory sized crankcase heater to control oil dilution.
 3. Each mounted on spring vibration isolators with an isolation efficiency of not less than 95 percent.
 4. Speed shall not exceed 1750 rpm.
 5. Cycles per hour per compressor shall not exceed six.
 6. Shall have four-stage step-down ability, of 25%, 50%, 75% and 100% with minimum of two compressors.
- E. Cooler:
1. Shell-and-tube type with removable heads.
 2. Tubes shall be internally enhanced seamless copper type rolled into tube sheets.
 3. Equipped with flanged type water connections.
 4. Shell shall be insulated with 3/4-in. closed cell PVC foam of maximum K factor 0.28.
 5. Equipped with electric heaters along the shell under the insulation to protect against cooler freeze-up.
 6. Design shall incorporate two independent direct expansion refrigerant circuits.
- F. Condenser: Coil shall be air-cooled with integral sub-cooler, constructed of aluminum fins mechanically bonded to seamless copper tubes which are then cleaned, dehydrated and sealed.
- G. Refrigeration Components: Refrigerant circuit components shall include hot gas muffler, high side pressure relief device, liquid line shutoff valve, suction and discharge pressure gauges with manual shutoff valves, replaceable core filter drier, moisture indicating sight glass, stepper motor, actuated electronic expansion valve, and compressor oil.
- H. Controls, Safeties and Diagnostics:
1. Controls:
 - a) Unit controls shall include the following minimum components:
 - 1) Microprocessor
 - 2) Power and control circuit terminal blocks.
 - 3) On/off control switch.
 - 4) Replaceable solid state relay panel.
 - 5) Leaving chilled water set point panel.
 - 6) Thermistors and/or potentiometers.
 - 7) All starters, contactors, relays, control components for a complete and operable system, motor starters for compressor to be reduced voltage type.
 - b) Capable of performing the following functions:

- 1) Automatic compressor lead-lag.
 - 2) Pumpout at beginning and end of every circuit cycle.
 - 3) Capacity control boxed on leaving chilled water temperature and compensated by rate of change of return water temperature pulldown rate at start-up to 1F per minute to prevent excessive demand spikes (charges) at start-up.
- c) Control compartment shall be equipped with 115V convenience outlets.
2. Safeties:
- a) Unit shall be equipped with thermistors and/or potentiometers and all necessary components in conjunction with the control system to provide the unit with the following protections:
 - 1) Loss of refrigerant charge protection.
 - 2) Low water flow protection.
 - 3) Low chilled water temperature protection.
 - 4) Low and high superheat protection.
 - 5) Low oil protection for each compressor circuit.
 - 6) Low control voltage (to unit) protection.
 - 7) Ground current protection for each compressor which shuts down compressor when no more than 2.5 supply amps are measured to prevent formation of acids.
 - b) Compressors shall be equipped with the following manual reset-type protection:
 - 1) Thermal overload.
 - 2) Pressure overload.
 - 3) Electrical overload through the use of definite-purpose contactor and calibrated, ambient compensated, magnetic trip circuit breakers. Circuit breakers shall open all 3 phases in the event of an overload in any one phase, or single phasing condition.
 - c) Fan motors shall have inherent overcurrent protection.
3. Diagnostics:
- a) Diagnostics display module shall be capable of indicating the safety lockout condition through displaying a 2-number code for which a legend shall be provided in control panel. Protections included for display shall be:
 - 1) Compressor lockout.
 - 2) Loss of charge.
 - 3) Low water flow.
 - 4) Low oil pressure.
 - 5) Cooler freeze protection.
 - 6) High or low suction superheat.
 - 7) Thermistor or potentiometer malfunction.
 - b) Module in conjunction with the microprocessor must also be capable of displaying the output (results) of a run test to verify operation of every switch, thermistor, potentiometer, fan, and compressor before chiller is started.
- I. Operating Characteristics:
1. Unit shall be capable of starting and running at outdoor ambient temperatures up to 115F (46.1C) per maximum load criteria of ARI Standard 590.

2. Unit shall be capable of starting up with 95F (35C) entering water temperature to the cooler.
- J. Motors:
1. Compressor motors shall be cooled by suction gas passing around motor windings.
 2. Condenser fan motors shall be 3-phase type with permanently lubricated bearings and class B insulation.
- K. Electrical Requirements:
1. Unit primary electrical power supply shall be connected to a single point.
 2. Unit shall operate of 3 phase, 60 cycle power at the volume shown in the equipment schedule.
 - a) Selection based on Carrier, Trane, and York, approved equal, provided they meet the performance specification and space limitations.

END OF SECTION 23 62 00

SECTION 25 00 00 - INTEGRATED AUTOMATION INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Integrated Automation Work, as indicated on the Drawings, and specified herein. Integrated Automation work indicated on the Drawings and/or specifications covering other trades shall conform to Division 25 of these Specifications.
- B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Integrated Automation systems shall be accomplished without additional cost to the Owner.
- C. Furnish all labor and materials required for Integrated Automation service connections to all the various items of equipment requiring controls service throughout the project shown on the Contract Drawings (even if not shown on Integrated Automation Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 INTEGRATED AUTOMATION DIVISION INDEX

- 250500 GENERAL INTEGRATED AUTOMATION REQUIREMENTS
- 251000 DIRECT DIGITAL CONTROL (DDC) SOFTWARE AND COMPONENTS
- 256000 MECHANICAL AND ELECTRICAL COORDINATION SCHEDULE

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 25 00 00

SECTION 25 05 00 - GENERAL INTEGRATED AUTOMATION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General Mechanical Requirements specifically applicable to Division 25 sections in addition to Division 1- General Requirements.
- B. Scope:
 - 1. The work covered by this division consists of performing all operations in connection with the installation of heating, cooling, ventilating, and plumbing including site utility work as indicated under this section. This entire section applies to all mechanical work and all mechanical sections of these specifications. This Contractor shall read and comply with all sections of these specifications including all General and Special Conditions.

1.2 REFERENCES

- A. Standard Requirements:
 - 1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. All work shall be executed in accordance with the local and state codes, ordinances, and regulations governing the particular class of work involved. This Contractor shall be responsible for the final execution of the work under this heading to suit these requirements. In the event of a conflict between the various codes and standards, the more stringent shall govern. Where these specifications and accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect/Engineer. The Architect/Engineer shall prepare any supplementary drawings required, illustrating how the work may be installed so as to comply. On approval of the change by the Architect/Engineer, the Contractor shall install the work in a satisfactory manner without additional cost to the Owner. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved, and on completion of the work, this Contractor shall obtain and deliver to the Owner final certificates of acceptance. This Contractor shall furnish copies of each certificate to the Architect/Engineer.
- C. The Contractor shall secure all permits and licenses for his work and shall pay all fees in connection with such permits and licenses.
- D. The contractor shall hold and save the Owner free and harmless from liability of any nature or kind arising from his failure to comply with codes and ordinances.
- E. Any and all meter deposits and all utility extension costs shall be paid by the Contractor whose work is done in connection with the service that the meter is connected to.

F. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

1. AABC Associated Air Balance Council
2. ADC Air Diffusion Council
435 North Michigan Ave.
Chicago, IL 60611
3. AMCA Air Movement and Control Association
30 West University Drive
Arlington Heights, IL 60004
4. ANSI American National Standards Institute
1430 Broadway
New York, NY 10018
5. ASHRAE American Society of Heating Refrigerating and Air
Conditioning Engineers
345 East 47th Street
New York, NY 10017
6. ASME American Society of Mechanical Engineers
345 East 45th Street
New York, NY 10017
7. ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103
8. FM Factory Mutual System
1151 Boston-Providence Turnpike
Norwood, MA 02062
9. FS Federal Specification
General Services Administration
Specifications and Consumer Information Distribution
Section (WFSIS)
Washington Navy Yard, Building 197
Washington, DC 20407
10. NBFU National Board of Fire Underwriters
5530 Wisconsin Avenue, Suite 750
Chevy Chase, Maryland 20815
11. NEC National Electric Code (of NFPA)
12. NEBB National Environmental Balancing Bureau
8224 Old Courthouse Road
Vienna, VA 22180
13. NEMA National Electrical Manufacturer's Association
2101 L Street, NW
Washington, DC 20037
14. NSF National Sanitation Foundation
Box 1468
Ann Arbor, MI 48106
15. OSHA Occupational Safety and Health Administration
U.S. Department of Labor
16. SMACNA Sheet Metal and Air Conditioning Contractor's
National Association

- 8224 Old Courthouse Road
Vienna, VA 22180
17. TIMA Thermal Insulation Manufacturers Association
Technical Services
1420 King Street
Alexandria, VA 22314
18. UL Underwriters Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062

- G. Underwriters Laboratories Inc. (UL): All materials, appliances, equipment, devices, or appurtenances shall conform to the applicable standards of Underwriters Laboratories Inc., where such standards have been established.

1.3 DRAWINGS

- A. Drawings and specifications shall be considered as cooperative, and work or materials called for by one and not mentioned in the other, or vice versa, shall be done and furnished as though treated by both.
- B. In the cases of discrepancies in figures, drawings, or specifications, the Architect/Engineer shall be notified immediately, and his decision shall determine the necessary adjustment. Without such decision, said discrepancies shall not be adjusted by the Contractor save only at his expense, and, in case of any settlement or any complication arising from such adjustment to the Contractor, he shall bear all extra expense involved.
- C. Should it appear that the work intended to be done, or any of the matters relative thereto, are not sufficiently detailed or explained on the drawings or specifications, the Contractor shall apply to the Architect/Engineer for such further drawings or explanations as may be necessary, allowing a reasonable time for the Architect/Engineer to supply same, and the Contractor shall conform to same as part of the Contract.
- D. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, reference shall be made to the Architect/Engineer whose decision shall be final and conclusive. No alleged oral admission, condonation, or inadvertent neglect on the part of the Architect/Engineer will be accepted as an excuse for inferior work.
- E. The mechanical plans do not give exact details as to elevations of ductwork and piping, exact locations, etc., and do not show all offsets, control lines, pilot lines, and other installation details. The Contractor shall carefully lay out his work at the site to conform to the structural conditions, provide proper grading of lines, to avoid all obstructions, to conform to details of installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated, satisfactory operational installation.
- F. Should the particular equipment which any Bidder proposes to install, require other space conditions than those indicated on the drawings, the Bidder shall arrange for such space with the Architect/Engineer before submitting his bid. Should changes become necessary on account of failure to comply with these details, the Contractor shall make such necessary changes at his (the Contractor's own expense).

- G. The Contractor shall submit working scale drawings of all his apparatus and equipment which in any way varies from these specifications and plans which shall be checked by the Architect/Engineer and approved before the work is started, Contractor before work proceeds. Interference with structural conditions shall be corrected by the Contractor.
- H. All equipment shall be installed in accordance with the manufacturer's recommendations. Provide all accessories and components for optimum operation as recommended by the manufacturer.

1.4 SYSTEM DESCRIPTIONS

- A. Not Used.

1.5 PRIOR APPROVALS

- A. Each equipment item for which the Contractor desires to install equipment other than the specific item identified in the equipment schedule or equivalent equipment by manufacturers specifically named in the schedule, the Contractor shall bear full responsibility to prove to the Engineer that the furnished equipment is equivalent to or better than the specified item. Failure to provide such proof will result in rejection of the shop drawing submittal by the Engineer. Prior written or verbal approval by the Engineer of equipment by other manufacturers will not relieve the Contractor of responsibility to provide equivalence. Prior approval is not required, however, any prior approval given is intended only to provide preliminary agreement that the alternate manufacturer may make equipment that complies with the specification requirements and not that all equipment manufactured by him is acceptable.

1.6 SHOP DRAWINGS

- A. Shop drawings or fully descriptive catalog data shall be submitted by the Contractor for all items of material and equipment furnished and installed under this Contract. This shall include piping, ductwork, mechanical equipment, plumbing equipment, control items, etc. The Contractor shall submit to the Architect/Engineer a sufficient number of copies of all such shop drawings or catalog data to provide him with as many review copies as he may need, plus three (3) copies for retention by the Architect/Engineer. No materials or equipment shall be installed until officially approved by the Architect/Engineer.
- B. Before submitting Shop Drawings to the Architect/Engineer for review, the Contractor shall examine them and satisfy himself that they are correctly representative of the material or equipment to which they pertain. The Contractor shall so note these Drawings before submitting them. The Contractor's review of Shop Drawings is not intended to take the place in any way of the official review of the Architect/Engineer, and the Shop Drawings which have not been reviewed by the Architect/Engineer shall not be used in fabrication or installing any work.
- C. The review of Shop Drawings or catalog data by the Architect/Engineer shall not relieve the Contractor from responsibility for deviations from the plans and Specifications unless he has, in writing, specifically called attention to such deviations as the time of submission and has obtained the permission of the Architect/Engineer thereon, nor shall it relieve him from the responsibility for error of any kind in Shop Drawings. When the

Contractor does call such deviations to the attention of the Architect/Engineer, he shall state in his letter whether or not such deviations involve any extra cost. If this is not mentioned, it will be assumed that no extra costs are involved for making the change.

- D. After receiving approval on the make and type of materials, the Contractor shall order such materials in sufficient time so that no delay or changes will be caused. This is done to facilitate progress on the job and failure on the part of the Contractor shall render him liable to stand the expense of any and all delays occasioned by failure on this part to provide necessary details. All shop drawings shall be delivered to the Architect/Engineer's office within thirty (30) days from the date of the contract.
- E. Shop drawings will be returned unchecked unless the following information is included: reference to all pertinent data in the Specifications or on the drawings, size and characteristics of the equipment, name of the project and a space large enough to accept an approval stamp. The data submitted shall reflect the actual equipment performance under the specified conditions and shall not be a copy of the scheduled data on the drawings.

1.7 SUBMITTALS

- A. Submittal data shall be organized in commercial quality, three ring binders with durable and cleanable covers. Product information for each piece of equipment shall be separated by an indexing leaf with clear tabs. The product name and symbol (i.e. AHU/Air Handling Unit) shall be typed on white paper inserts and placed in appropriate tab. Complete data must be furnished showing performance, quality and dimensions. A signed review by the Architect/Engineer must be obtained before purchasing any equipment.
- B. The following items shall be submitted for review by the Architect/Engineer but are not limited to:
 - 1. Temperature Controls
 - 2. Vibration Equipment and Calculations

1.8 QUALITY ASSURANCE

- A. General: Comply with Division 1.
- B. Welder Qualifications: Welders shall be certified by the American Society of Mechanical Engineers (ASME) National Certified Pipe for the type of work being performed. Current operators' certificates in accordance with ASME standards shall be on file at the site and shall be available to the Architect/Engineer for examination. Coupons shall be available for review by the Architect and Engineer.
- C. Locations of all pipes, ducts, outlets, appliance, etc., as shown on the drawings, are approximate only and are understood to be subject to such revisions as may prove necessary or desirable at the time the work is installed. Each Contractor will be required to install his work with relation to existing building conditions and shall be entirely responsible for the correctness of his work with reference to finished elevations, etc.

Piping shown on the drawings is diagrammatic only and their exact locations, depths, and invert elevations shall be as required for proper flow and coordination with other trades.

- D. The contract drawing depicts graphically the arrangement of piping and ductwork. Should local conditions necessitate a rearrangement, or if any of the piping or ductwork can be installed to better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit three (3) copies of Drawings of the proposed arrangement for the Architect/Engineer's review.
- E. If the Contractor proposes to install equipment, including piping and ductwork, requiring space conditions other than those shown, or to rearrange the equipment, he shall assume full responsibility for the rearrangement of the space and shall have the Architect/Engineer review the change before proceeding with the work. The request for such change shall be accompanied by Shop Drawings of the space in question.
- F. Each Contractor is responsible for the proper location and size of all slots, holes, or openings in the building structure pertaining to his work, and for the correct location of pipe sleeves.
- G. Each Contractor shall coordinate his work with that of all other trades that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines which require a stated grade for proper operation. Drainage lines shall take precedence over water lines in determination of elevations. In all cases, lines requiring a stated grade for their proper operation shall have precedence over electrical conduit and ductwork.
- H. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Lubricate all equipment properly in accordance with manufacturer's instructions. Furnish zerk grease fittings on all greaseable bearings.
- I. Equipment and Materials: The materials and equipment shall be new and shall be the standard products of the manufacturers regularly engaged in the production of Plumbing, Heating, Cooling, Ventilation, and Fire Protection Equipment, and shall be the manufacturer's latest standard design. Where two or more units of the same class of equipment are required, these units shall be the products of the same manufacturer. However, the component parts of the systems need not be the products of the same manufacturer. Specific equipment specified hereinafter is to be considered a standard of quality and operation. In general, all capacities of equipment, and motor and starter characteristics are shown in schedules on the drawings. Reference shall be made to the schedules for specific information. The capacities shown are minimum capacities. Variations in the characteristics will be permitted only on written approval of the Architect/Engineer. All equipment shall be shipped to the job with not less than a prime coat of paint or as specified hereinafter. Insofar as is possible all items of the same type (i.e., pumps, fans, etc.) shall be by the same manufacturer. Where installation instructions are not included in these specifications or on the plans, the manufacturer's instructions shall be followed. All equipment affected by altitude shall be rated to operate at the altitude where it is to be installed.
- J. Excavation and Backfilling: This Contractor shall do all necessary excavation and backfill for the installation of the Mechanical systems as may be required. Curb cuts,

asphalt, and concrete patching, cutting and patching existing floor, etc., shall be part of this Contractor's responsibility. No extra payment will be made for rock excavation. Trenches for all underground piping shall be excavated to the required depths. The bottoms of trenches shall be tamped hard and graded to secure maximum fall. Bell holes shall be excavated to assure the pipe resting for its entire length on solid ground. Should rock be encountered, it shall be excavated to a depth of 6 inches below the bottom of the pipe, and before laying the pipe, the space between the bottom of the pipe and the rock surface shall be filled with gravel, thoroughly tamped. Pipe laid in trenches dug in fill shall be supported down in the trenches and shall be filled. No roots, rocks or foreign materials of any description shall be used in backfilling the trenches. The backfill material shall be identical to the surrounding fill material and shall be placed in 6-inch layer, wetted, and compacted to the density of the adjacent soil. See Division 2 for additional information for site utilities. All surplus materials shall be hauled from the project by the Contractor at his expense.

- K. Cutting and Repairing:
1. Responsibility of the Contractor whose work is involved. Coordinate with others to prevent unnecessary cutting and repairing.
 2. Lay out and locate equipment, openings, and chases. Install sleeves, inserts, and supports. Arrange with those whose work is involved to do cutting and replacing caused by negligence or error with costs reimbursed by the Contractor at fault. Cutting and replacing of existing work shall be the responsibility of the Contractor whose work is being installed.
 3. Removal or terminating connections of existing work which is abandoned or replaced shall also be done hereunder to provide correct and finished work.
- L. Foundations: All equipment shall be provided with suitable foundations and supports. It shall be the responsibility of the Contractor to provide for the proper locations of these foundations and supports. This applies to all rooftop equipment also.
1. All concrete foundations required by equipment furnished by the Mechanical Contractor shall be constructed by them (except where otherwise noted) the conformity with the recommendations of the manufacturer of the respective equipment, and with the approval of the Architect/Engineer. All corners of the foundations shall be neatly chamfered. Foundation bolts shall be placed in the forms when the concrete is poured. Allow 1 inch below the equipment base for alignment, leveling and grouting with non-shrinking grout. Grouting shall be done after the equipment is leveled in place. After the grout has hardened, the foundation bolts shall be pulled up tight and the equipment shimmed, if necessary. After removal of the forms, the surface of the foundation shall be rubbed.
 2. Unless otherwise noted, foundations shall be a minimum of 6-inch high. All concrete work performed by these Contractors shall conform entirely to the requirements of the Concrete Specifications which describe this class of work.
- M. Code Requirements: Comply with state and local code requirements and ordinances. Call for inspections required by responsible building inspection authority.

- N. Applicable Building Codes and Ordinances: Including the latest edition of each code, but not limited to the following:
1. International Building Code.
 2. Uniform Mechanical Code.
 3. Uniform Plumbing Code.
 4. Governing Fire Department Requirements
 5. Utility Company Requirements
 6. National Fire Protection Association Standards
 7. NFPA 70 - National Electrical Code
 8. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
 9. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems
 10. NFPA 13 - Sprinkler Systems
 11. NFPA 101 - Life Safety
 12. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment
- O. Access Panels
1. Similar to Milcor, or as noted on the drawings, size as required for concealed expansion joints, valving, gauges, balancing dampers, valves, traps, pitot stations, equipment and similar items requiring accessibility. Notify the General Contractor of each access panel location and the required size. Panels shall be proper type for ceiling or wall in which they are installed. The panels shall be furnished under this section of the Specifications, unless otherwise directed, but shall be coordinated to be compatible with walls and ceilings furnished under other sections.

1.9 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Division 1.
- B. Large Items: Make arrangements with other trades on the job for introduction into the building of equipment too large to pass through finished openings.
- C. Acceptance: Check and sign for materials to be furnished by others for installation under all Mechanical Divisions upon delivery. Contractor shall be responsible for the storage and safekeeping of such materials from time of delivery until final acceptance.
- D. Protection: Close ends of pipe and ductwork at the close of each working day during construction to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Protect fixtures and equipment against damage during mechanical work with heavy paper or plastic until final clean-up.
- E. Storage: Store equipment in covered enclosure or wrap with weather tight 6 mil Visqueen.
- F. Shipping Protection: Protective casings, crating, and coverings to remain in place until start-up of equipment.

1.10 PROJECT CONDITIONS

- A. Performance: All systems are to be rated at [5,500 ft.] elevation.

1.11 SEQUENCING AND SCHEDULING

- A. General: Comply with Division 1.
- B. Schedule: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.
- C. Utility Interruptions: Schedule mechanical utility interruptions with the Architect/Engineer/Owner minimum of seven (7) days prior to the requested outage. Plan work so that duration of the interruptions a maximum of one day.

1.12 CONTROLS WIRING AND ELECTRICAL EQUIPMENT

- A. All mechanical equipment controls wiring, conduit, relays, interlocks, and all accessories required for a completely operational controls system shall be the complete responsibility of the mechanical contractor. The mechanical contractor has the option to hire the project electrical contractor or any qualified controls contractor to install mechanical controls wiring and conduit. Refer to specification 251000 for installation requirements.
- B. Electrical items such as disconnect switches and motor starters associated with equipment provided by Division 25, when specifically mentioned to be furnished by the Mechanical Contractor, whether in these specifications or on the Electrical or Mechanical Drawings, shall be furnished by the Contractor. These items shall be mounted and connected as required for a completely operational system. See Control Systems Specification for further information.
- C. All electrical equipment characteristics (voltage, etc.) must be verified by the Contractor prior to ordering. If the Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, he shall first inform the Architect/Engineer of the change and shall then coordinate the change with the Electrical Contractor and shall pay all additional charges in connection with the change.

1.13 PROTECTION AGAINST HAZARDOUS CONDITIONS

- A. The Contractor shall take precautions against hazardous construction conditions at all times during construction. The final condition of the facilities shall be safe, and where safety to operating personnel is jeopardized, suitable signage shall be posted.
- B. Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operating personnel, shall be cut back and/or protected to reduce the risk of injury. All openings between floors shall be protected with barriers around the openings, gratings across the openings, or steel bars through the openings to avoid and protect against injury.

1.14 HAZARDOUS SIGNS

- A. Equipment room contains moving or rotating parts, floor openings, or other potentially hazardous environments and shall include a sign on the door entering it that shall read similar to the following: **Hazardous Area - Authorized Personnel Only.**

1.15 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. The Mechanical Contractor shall furnish to the Owner a bound manual in triplicate, containing complete repair parts lists, and operating, service, and maintenance instructions on all mechanical equipment, fixtures, and systems.
- B. The Mechanical Contractor shall also provide training as required by Section 230100 to the Owner's operation and maintenance personnel.

1.16 OPERATION PRIOR TO ACCEPTANCE

- A. The Owner shall have the right to operate any and all apparatus as soon as and as long as it is in operating condition, after Owner personnel have received operational training, whether or not such apparatus has been accepted as complete and satisfactory, except that this shall not be construed to mean operations before any required alterations or repairs have been made. This operation does not indicate acceptance of the equipment by the Owner. When the Contractor enters into a contract with the Owner, he agrees to the above.

1.17 WARRANTY AND SERVICE PROGRAM

- A. Due to the critical performance requirements and to clearly establish warranty responsibility for this project, the Contractor shall provide a full-service maintenance and warranty program to the Owner for one full year after beneficial occupancy (substantial completion).
- B. This service program shall be included as part of the base bid and shall include service, maintenance, repair, replacement, lubrication, temperature control calibration and repairs, and documenting proof for all service and maintenance work on all equipment and system furnished by the Contractor.
- C. A single representative in the employment of the Contractor shall be responsible for coordination and follow through of this program. This representative's name and phone number shall be submitted to the Owner as part of the maintenance manuals and supportive data. The Contractor shall respond to a request for service with 24 hours if so requested.
- D. During this first year of operation, the following sequence of maintenance service shall be performed as a minimum.
 - 1. Clean strainers in piping.
 - 2. Fans and/or pumps be lubricated and oiled once every four (4) months.

3. Controls shall be calibrated throughout the facility at the end of six (6) months (following substantial completion). Any leaks in the piping systems shall be repaired.
4. All equipment manufacturer's service recommendations shall be followed during this period.

1.18 FLUSHING AND DRAINING

- A. It shall be the responsibility of this Contractor to properly drain and flush all ducts and pipes before use or acceptance to ensure that all debris is completely removed. Damage caused by such debris remaining in the ducts or pipes shall be repaired by this Contractor at his expense. This Contractor shall demonstrate to the Architect/Engineer's representative that all piping is clean.

1.19 CLEANING

- A. This Contractor shall remove from the building construction site all rubbish and dirt as it accumulates under the contract. At completion, all areas shall be broom cleaned and all obstructions, surplus materials, etc., removed.

1.20 GUARANTEE

- A. The Contractor shall guarantee all materials, equipment, and workmanship furnished and installed by him under this Contract, to be free from all defects of workmanship and materials, and shall agree to replace at his expense, without expense to the Owner, at any time within one year after installation is accepted by the Architect/Engineer, any and all defective equipment, parts, etc., that may be found. (This excludes normal maintenance and daily servicing of equipment which is the Owner's responsibility.)

1.21 FLOOR, WALL, AND CEILING PLATES

- A. Where exposed pipes pass through floors, finished walls, or finished ceiling, they shall be fitted with chromium-plated escutcheons of an approved pattern. Escutcheons and plates in Mechanical Rooms do not require chrome finish.
- B. This Contractor shall be responsible for providing and installing all counter flashing. All openings in the roof shall be flashed and counterflashed. Use four-pound lead flashing materials for all vent lines and welded flashing in steel lines passing through roof. The Mechanical Contractor shall notify the General Contractor where each roof penetrations are and the size of the opening.

1.22 PIPE SLEEVES

- A. Schedule 40 steel pipe sleeves or pipe sleeves made of No. 20 gauge galvanized steel, properly secured in place with approximately 1/4" space between each sleeve and the surface of the pipe and/or insulation passing through it, shall be provided for all pipes passing through concrete floors, roofs, and masonry walls. All pipe sleeves shall be fixed in place as the walls and floors are built up. The Contractor shall furnish and locate all sleeves and pipes passing through concrete floors, exterior masonry walls, and roofs shall be made watertight with approved non-hardening plastic material. Sleeves through pipe

chase or equipment room floors shall project a minimum of 2-inch above the floor and shall be of black steel pipe with waterproof flange at center of floor thickness. Each sleeve through a fireproof wall shall be packed with approved fireproof rope in the annular space.

1.23 PIPE HANGERS

- A. Pipe hangers shall be Fee and Mason of a type suitable for each use. Perforated straps shall not be used in any work. For ferrous pipes up to and including 4 inch in size, use Fee and Mason Fig. 199 malleable iron, adjustable, split ring, swivel hanger. For plumbing piping larger than 4 inches, use Fee and Mason Fig 239 steel clevis hanger. Where several pipes are parallel at the same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be supported on rollers where indicated on the Drawings. For copper pipes up to and including 3 inch in size, use Fee and Mason Fig. 360 malleable iron, copper plated hangers. For copper pipes larger than 3 inch, use Fee and Mason Fig. 364 copper plated clevis hanger.
- B. Hanger rod sizes shall conform to the following schedule:
- | | | |
|----|-----------------------------|-----------|
| 1. | Pipe up to and including 2" | 3/8" rods |
| 2. | Pipe 2-1/2", 3" and 3-1/2" | 1/2" rods |
| 3. | Pipe 4" and 5" | 5/8" rods |
| 4. | Pipe 6" | 3/4" rods |
| 5. | Pipe 8", 10", and 12" | 7/8" rods |
- C. Unless shown otherwise on the Plans, all horizontal runs of ferrous piping shall be suspended from the floor or roof construction, as the case may be, by means of hangers with the following spacing:
- | | | |
|----|---------------------------------|-----|
| 1. | Pipe up to and including 1-1/4" | 8' |
| 2. | Pipe 1-1/2" and 2" | 10' |
| 3. | Pipe 2-1/2" and 3" | 12' |
| 4. | Pipe 3 1/2" and 4" | 14' |
| 5. | Pipe 5" and 6" | 16' |
| 6. | Pipe 8" and 10" | 20' |
- D. Unless shown otherwise on the Plans, all horizontal runs of copper piping shall be suspended from the floor or roof construction as the case may be, by means of hangers with the following maximum spacing:
- | | | |
|----|-------------------------|-----|
| 1. | Pipe up to 3/4" in size | 5' |
| 2. | Pipe 1" and 1-1/4" | 6' |
| 3. | Pipe 1-1/2" and larger | 10' |
- E. There shall be a hanger within 2 inches of each elbow or tee. Additional supports shall be provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length of pipe. Vertical risers shall be supported by approved riser clamps at each floor. Vertical pipes within a space shall have not less than two supports.

- F. Supports and hangers shall be installed to permit free expansion and contraction in the piping systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to control expansion and contraction, the piping shall be guided and firmly anchored. No piping shall be self-supporting, nor shall it be supported from equipment connection.
- G. Expansion bolts shall be Ackerman-Johnson or Hilti.
- H. Beam clamps suitable for use with this type of steel construction involved shall be Grinnell.

1.24 PRESSURE VESSEL CERTIFICATION

- A. Not used.

1.25 ISOLATION

- A. Excessive vibration or objectionable noise created in any part of the building by the operation of any equipment furnished and/or installed under the Mechanical Contract will be extremely objectionable and the Contractor shall take all precautions against the same by isolating the various items of equipment from the building structure and by such other means as may be necessary to eliminate all excessive vibration and objectionable noise produced by any equipment installed by them, and consequently, they shall design all foundations, supports, etc., for their equipment, and all piping with this end in view. In addition, these Contractors shall supervise the construction of all foundations and supports, whether they build them or not, in order that they may be constructed in such a manner as to prevent the transmission of objectionable noise and/or excessive vibration. Submit calculations on all vibration isolation equipment.
- B. All equipment having moving parts shall be isolated from the building structure by means of Korfund isolation materials, unless specifically noted otherwise. All isolators shall be the same brand and shall be supplied from the same source. Equipment manufacturer's recommendations shall be followed in the isolation of equipment.
- C. Vibration isolators shall have sufficient resilience to meet the following minimum efficiencies:

<u>Motor HP</u>	<u>Equipment Room</u>
Up to 5	90%
7-1/2 to 15	93%
20 to 40	95%
50 to 100	97.5%
- D. Spring isolators shall be of the housed type with ribbed pads bonded to the underside of the baseplate or may be unboxed stable springs. Isolators shall be furnished with snubbers and limit stops where so recommended by the equipment manufacturer.
- E. The Supplier of the isolating equipment shall, upon completion of the job, check all isolating materials and verify that they are installed properly, and submit a report in writing to the Architect/Engineer.

1.26 TESTING

- A. Before completion of this project, the Mechanical Contractor shall test all materials and equipment which normally require testing. All piping, etc., shall be tested to meet code requirements or the Specification requirements, whichever is more stringent.
- B. All equipment shall be operated sufficiently long enough to prove to the Architect/Engineer that the equipment performs satisfactorily and meets the requirements set forth on the Plans or in these Specifications.

1.27 CERTIFICATIONS

- A. Before receiving final payment, the contractor shall verify that all equipment furnished, and all work done is in compliance with all applicable codes mentioned in these Specifications. Submit certifications and acceptable certificates to the Architect/Engineer.

1.28 GENERAL PIPING INSTALLATION REQUIREMENTS

- A. Provisions for Drainage: All piping systems shall be installed so that they may be easily drained. Drain caps, plugs, or hose bibbs shall be installed at low points. Grade piping toward drain locations.
- B. Alignment: All installed pipelines shall be straight and shall remain straight against strains. Proper allowance shall be made for expansion and contraction.
- C. Clean as Installed: All piping shall be kept free from scale or loose dirt when installed and must be kept clean during the completion of the installation. All openings in the piping system shall be capped or plugged while awaiting further connections. All detergents, solvents and other cleaning agents shall be compatible with the materials of fabrication of the system in which they are used. They shall not adversely affect the materials of mechanisms in the systems and they shall be acceptable to equipment manufacturers. All detergents, solvents, and other cleaning agents shall also be compatible with the process streams to be handled by the systems in which they are used.
- D. Insulated Fittings: Install between any dissimilar metals such as steel and copper.
- E. Expansion and Contraction: The Contractor shall make all necessary provisions for expansion and contraction with proper fittings, anchors, dresser couplings, loops, etc. Install flexible connectors on each pipe at each building expansion joint.
- F. Welding: Refer to Paragraph 1.29 of this section of these specifications.
- G. Bending: No bending of pipe will be permitted.
- H. General: The installation shall be coordinated with respect to space available with heating, cooling, ventilating, and electrical installation. In every instance where there is a conflict in the routing of the piping and the ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows, shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to

measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Cutting or weakening of structural members to facilitate piping, installation is not permitted. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall be run parallel with the lines of the building unless otherwise noted on the drawings. Unless otherwise shown on the drawings, horizontal piping shall pitch down in the direction of flow with grade of not less than 1 inch in 40 feet. Piping connections to equipment shall be in accordance with details shown on the drawings or as recommended by the equipment manufacturer. Service pipe valves and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 1/2 inch from such other work, and not less than 1/2-inch between finished covering on the different services.

- I. Installation of Valves: Valves shall be installed at the locations shown on the drawings and where specified and where directed at site. Gate valves shall be used unless otherwise shown, specified, or directed. All valves shall be installed with their stems horizontal or above. Where tight shutoff is required, a composition seat globe valve or resilient seat ball valve shall be used.
- J. All valves which must be used during operation, all control valve assemblies, instrument control cases, liquid level controls, gage glasses, orifices, relief valves, and other equipment which must be observed, adjusted, or serviced during operation shall be located conveniently accessible from an operating platform or grade.
- K. In general, relief valves within processing unit limits shall be located conveniently accessible from an operating platform or grade.
 - 1. Those in non-hazardous service, such as water, shall discharge directly to outside.
 - 2. Relief valves should have no piping between the vessel or line and the valve inlet, except as shown on the drawings.
 - 3. Relief valves shall be installed in a vertical position. Vent piping shall be braced and supported in a manner that will not produce excessive stresses in the relief valve and will permit removal of the relief valve without necessary temporary supports for the vent lines.
- L. Equipment Connections: All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment. The contractor shall be required as directed to remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected. Pipe connections to equipment shall be made with unions or flanged fittings. Provide removable headers for large equipment for service access.
- M. Joints
 - 1. Flanged Joints: All flanged joints shall be face matched. Raised face flanges shall not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be turned off. All flanged bolt holes shall straddle the horizontal and vertical center line unless otherwise noted.

2. Screwed Joints: Screwed pipe joints shall have American Standard Taper Pipe Threads ANSI-B2.1 Latest Edition. Burrs formed when cutting pipe shall be removed by reaming. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. Joints shall be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound.
 3. Solder-Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool or wire brush before seating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for serrated fittings on water, compressed air below 60 psig, and vacuum lines shall be made with a 95 percent tin and 5 percent antimony. Cored solder or solder containing lead will not be permitted.
- N. Reducers: Reduction in pipe size shall be made with one piece reducing fittings. Bushings reducing at least two pipe sizes will be acceptable only when there is no room for reducing couplings or swaged nipples.
- O. Unions: All piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings specified with which they are used. Union Pressure classes and end connections shall be the same as the fittings used in the lines with the unions. Steel unions shall have hardened stainless steel seating surfaces on both faces.

1.29 WELDING

- A. All welding of piping covered by this specification, regardless of condition of service shall be accompanied as follows:
1. The welding shall be in accordance with the recommendations of the American Welding Society. Mitering of pipe to form elbows, notching to form these, or any similar construction will not be permitted. Welding fittings shall be installed on all welded lines. Joints to be welded shall be properly aligned and spaced, using special welding clamps where necessary. All welders to be employed shall have passed qualification tests prescribed by the National Certified Pipe Welding bureau (or by another reputable testing laboratory or agency) using procedures approved by the American Society of Mechanical Engineers or the American Welding Society. The welders will be required to pass qualification tests when the work of the welder creates a reasonable doubt as to his proficiency. Tests shall be conducted at no additional expense to the Owner.
 2. Each welder shall, in addition to having passed the prescribed qualification tests (as noted in Paragraph 1.30.A.1), prepare sample coupons at the job site on a portion of pipe that is cut such that the cross section of the weld is opened to view. The sample weld should be prepared using a 6-inch diameter pipe. The sample shall reflect a continuous weld with perpendicular cut out to show the weld in cross sectional view. This sample, when accepted and approved by a certified welding inspector, shall be used as a standard of quality to compare to other welds that this welder will be performing on the job. This same sample weld will also be a basis for accepting or rejecting the welder for working on this project. The sample weld shall be identified with a date and the welder's name and shall be kept at the site throughout the project.

3. All welding on pressure piping shall conform to all of the requirements of the American Society of Mechanical Engineers Code for Pressure Piping - B31.1 (An American National Standards Institute publication), as defined in the latest edition of the ANSI Power Piping B31.1 Manual. All welding shall also conform to all of the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. All chapters, current addenda and supplements of these manuals shall apply. This code shall be used to establish standards of performance and quality of welds. However, the Owner reserves the right to perform radiographic testing of all welds, to compare any of the welds to the approved "standard" sample welds of each welder, and to compare the welds to the welding diagrams and sketches of those recommended in the ANSI B31.1 Power Piping Manual. The intent is to obtain the highest quality welding job possible. The cost of any initial radiographic testing, for random inspection, shall be paid for by the Owner. If radiographic random testing reveals that a weld is defective, the Contractor shall bear the cost of all repairs and re-testing necessary to be made to subject weld until conformance with radiographic tests is reached. The potential for random radiographic testing and welding quality control applies to all pressure piping systems in this project, including systems below 100 psig. If a question should arise regarding the possibility of faulty welding or if there are obvious visual defects in the welding, the Contractor shall be required to correct such deficiencies to a quality level consistent with the recommendations, welding diagrams and sketches in the ANSI B31.1 Manual. The quality level shall also reflect that of the approved sample welds accomplished by each welder for this particular project.

1.30 COOPERATION WITH OTHER TRADES

- A. The Contractor shall refer to other sections of these specifications covering the work of other trades which must be carried out in conjunction with the mechanical work so that the construction operations can proceed without harm to the Owner from interference, delay, or absence of coordination.

1.31 FIELD MEASUREMENTS

- A. The Contractor shall verify the dimensions covering the mechanical work at the building. No extra compensation shall be claimed or allowed on account of difference between actual dimensions and those indicated on the drawings. He shall examine the adjoining work on which Mechanical work is dependent for maximum efficiency and shall report any work which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting Mechanical work.

1.32 SAFETY GUARDS

- A. The Mechanical Contractor shall furnish and install safety guards required in order to obtain certificates of inspection from all authorities having jurisdiction. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded. Provide coupling guards on all rotating shafts.

1.33 PROTECTION

- A. All work, equipment, and materials shall be protected at all times to prevent obstruction, damage, or breakage. All pipe openings shall be closed with caps or plugs during installation. All equipment shall be covered and protected against dirt, water, chemical, or mechanical injury. At the completion of the work, all equipment shall be thoroughly cleaned, and the entire system shall be delivered in a perfect, unblemished condition.

1.34 PAINTING AND IDENTIFICATION

- A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be marred in transit or during installation, it shall be finished to present a neat, workmanlike appearance.
- B. Except as elsewhere hereinafter specifically required, any painting of equipment, piping, ductwork, grilles, insulation, etc., furnished and installed under this Section of the Specifications will be done by the Painting Contractor. However, the Mechanical Contractor shall leave his equipment clean and free from any grease, dirt, rust, etc., and in suitable condition for painting.
- C. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during the painting operation.
- D. The piping shall be painted the basic color as indicated in other sections of these specifications and shall be marked every 10 feet on centers with Brady pipe markers. Arrows, approximately 6 inch in length and spaced about 10 feet on centers shall indicate the direction of the flow pipe. Locate additional labels as required in Mechanical Rooms. Staple in place, brush with clear lacquer. Markers shall state pipe size, flow direction, and pipe usage (such as "cold water," etc.).

1.35 RECORD DRAWINGS

- A. The Contractor shall, during the execution of the work, maintain a complete set of drawings upon which all dimensional locations of equipment piping and all deviations and/or changes in the work shall be recorded. Water, storm, and drainage mains shall be delivered to the Architect/Engineer in good condition upon the completion and acceptance of the work and before final payment is made.

1.36 SUPPLIER RESPONSIBILITY

- A. Each supplier, whether furnishing equipment as specified or as a substitution shall be responsible for certifying that the equipment is properly installed and that the warranty is valid. Submit written reports on the installation and the equipment performance when requested to do so by the Architect/Engineer (or his representative). Each supplier shall be responsible for furnishing qualified personnel at the job site at anytime requested by the Architect/Engineer (or his representative) during the construction or warranty periods.

END OF SECTION 25 05 00

SECTION 25 10 00 – DIRECT DIGITAL CONTROL (DDC) SOFTWARE, INSTALLATION, AND COMPONENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes all devices, equipment, wire, conduit, and installation of all required parts and performance criteria for furnishing all labor and materials for the installation and programming for Direct Digital Control for HVAC Systems utilizing wireless communication with cloud-based servers.

1.2 RELATED SECTIONS

- A. Division 01: General Requirements.
- B. Section 23: Heating, Ventilating, and Air-Conditioning (HVAC).

1.3 SUBMITTALS

- A. Shop Drawings and product data in accordance with the specifications.
- B. All shop drawings shall be prepared in AutoCAD 2016 or newer. In addition, Contractor shall provide drawings in electronic format with x-ref and layer information to other trades as required.
- C. All submittals shall be bound or in a three-ring binder with a table of contents and related section tabs. Five (5) copies shall be submitted to the Architect/Engineer for distribution and review.
- D. Shop drawings shall include basic floor plans depicting locations of all equipment and wiring, installed by others, to be controlled by system and locations of thermostats, gateways and other equipment provided under this section. Drawings shall also show location of electrical power, low voltage wiring and data ports, provided by the contractor, required for proper installation of systems of this section.
- E. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification.
- F. Submit five (5) copies of submittal data and shop drawings to the Engineer for review prior to ordering or fabrication of the equipment. The Contractor prior to submitting shall check all documents for accuracy.
- G. The Engineer will make corrections, if required, and return to the Contractor. The Contractor will then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully approved.

1.4 SCOPE OF WORK

- A. Except as otherwise noted, the control system shall consist of any and all wiring devices, equipment, thermostats, gateways, etc. to fill the intent of the specification and provide for a complete and operable system.
- B. The DDC contractor shall review and study existing building/site conditions where applicable and all new construction drawings for the project including HVAC drawings and the entire project specifications to familiarize themselves with the equipment and system operation prior to bidding and submittal of a bid/price and notify the owner immediately of any conflicts between the project and the scope of work of this section, including work to be completed by others.
- C. All equipment and installation of control devices associated with the equipment listed below shall be provided under this Contractor.
- D. Related work for interconnection:
 - 1. Products Supplied but Not Installed Under This Section:
 - a. Control valves.
 - b. Flow switches.
 - c. Wells, sockets, and inline hardware for water sensors (temperature, pressure, flow).
 - d. Automatic control dampers, where not supplied with equipment.
 - e. Variable frequency drives. (Does not include VFDs integral to chillers or boilers).
 - 2. Products Installed but Not Supplied Under This Section: None.
 - 3. Products Not Furnished or Installed but Integrated with the Work of This Section:
 - a. Chiller control systems.
 - b. Boiler control systems.
 - c. Chemical water treatment.
 - d. Smoke detectors (through alarm relay contacts).
 - 4. Work Required Under Other Divisions Related to This Section:
 - a. Power wiring to line side of motor starters, disconnects or variable frequency drives.
 - b. Provision and wiring of smoke detectors and devices relating to fire alarm system.
 - c. Campus LAN (Ethernet) connection adjacent to gateways or global controllers Operator Workstation.
- E. When the DDC system is fully installed and operational, the DDC Contractor will make themselves available to meet with the designated representatives of the owner to review the as-installed condition of the system. At that time, the DDC contractor shall demonstrate the operation of the system and prove that it complies with the intent of the drawings and specifications.
- F. The Contractor shall furnish and install a complete DDC control system including all necessary hardware, wiring, conduit, etc., and all operating and applications software

necessary to perform the control sequences of operation as called for in this specification. Provide and Install DDC controls for the HVAC Equipment as noted on the drawings:

- G. Provide technical support necessary for commissioning of system in coordination with the HVAC Contractor, Balancing Contractor, and the owner's team.
- H. Contractor shall provide one training session in the operation of the system, for owner's personnel, a minimum of 4 hours in duration. In addition, see General HVAC Requirements for maintenance requirements and M&O Manuals.
- I. All work performed under this section of the specifications will be in compliance with all codes and regulations as mandated by the authority having jurisdiction

1.5 SYSTEM DESCRIPTION

- A. The Direct Digital Control (DDC) shall consist of thermostats, gateways and related accessories as indicated below and all related programming for a complete and fully operational web-based management system using a cloud server program complying with the following specifications.
- B. The entire Direct Digital Control (DDC) shall include a network of commercial Internet programmable thermostats which use IEEE 802.15.4 mesh wireless communication protocol to reach a Wireless Gateway (WG). The WG must connect to the owner's wide area network (WAN) over a TCP/IP connection. Access and control of DDC is through a web-based management tool which sits on a cloud server and must be accessible either locally or remotely via the Internet.

1.6 WORK BY OTHERS

- A. The DDC Contractor shall coordinate with other contractors prior to performing the work on this project and cooperate as necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others' work prior to fabrication and installation. The Architect/Engineer representative shall be immediately notified if an area of conflict occurs between trades prior to fabrication and installation. DDC Contractor shall provide pre-installation of control components.
- B. Low voltage thermostat wiring between equipment and thermostat locations shall be furnished and installed by this contractor. Unless noted otherwise all new low voltage wiring shall be multiple conductor thermostat wiring (wire count as indicated in Thermostat Manufacture's installation instructions) installed per these specifications. (Installations shall be minimum 3 conductor / 24-gauge wires per DDC manufacturer's standard specifications, multiple conductor/24-gauge thermostat wiring preferred).
- C. Related work provided by others:
 - 1. 110 V outlets shall be provided within 5 feet of each gateway location.
 - 2. 1 Data port shall be provided within 10 feet of each gateway location.
- D. Equipment start-up and servicing

1.7 CODE COMPLIANCE

- A. Provide DDC components and ancillary equipment which are code compliant.
- B. All wiring shall conform to the National Electrical Code.
- C. All products of the DDC shall reside with the following agency approvals.
 - 1. California 2016 Title 24 Compliant.
 - 2. California Energy Commission Occupant Control Smart Thermostat (OCST) certified.
 - 3. Open ADR 2.0 certified.

1.8 SYSTEM STARTUP & COMMISSIONING

- A. Each DDC component in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the DDC will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report will be submitted to the owner indicating that the installed system functions in accordance with the plans and specifications.
- B. The DDC Contractor shall provide all manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building. The DDC Contractor shall have a trained technician available during the balancing of the systems. The DDC Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and shall include all labor and materials in his contract to assist with functional testing of system as it relates to DDC.

1.9 TRAINING

- A. The DDC Contractor shall provide training for two (2) owner's representatives and/or maintenance personnel. The DDC Contractor shall provide on-site training to the District's representative(s) and maintenance personnel per the following description.
- B. On-site training shall consist of a minimum of 4 hours, as indicated above of hands-on instruction geared at the operation and maintenance of the systems. The curriculum shall include:
 - 1. System Overview
 - 2. System Software and Operation
 - 3. System Access
 - 4. Software Features Overview
 - 5. Changing Set Points and Other Attributes
 - 6. Scheduling
 - 7. Editing Programmed Variables
 - 8. Displaying Color Graphics
 - 9. Running Reports
 - 10. Workstation Maintenance

11. Application Programming
12. Operational Sequences, Including Start-Up, Shutdown, Adjusting, and Balancing
13. Equipment Maintenance

1.10 OPERATING AND MAINTENANCE MANUALS

- A. The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation, and parts procurement for the entire DDC. This documentation shall include specific part numbers.
- B. Following project completion and testing, the DDC contractor will submit as-built documentation and M&O reflecting the exact installation of the system.

1.11 WARRANTY

- A. The DDC Contractor shall warrant the system for 12 months after system acceptance and beneficial use by the District. During the warranty period, the DDC contractor shall be responsible for all necessary revisions to the software as required to provide a complete and workable system consistent with the letter and intent of the Sequence of Operation section of the specification. DDC equipment shall be warranted for a period of 5 years from the time of system acceptance.
- B. Warranty of equipment is limited to replacement of defective products.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Unless noted otherwise, all products shall be of a single manufacturer. The standard of design and quality shall be products as manufactured by Pelican Wireless Systems, or a prior approved equal. See prior approval process in related sections.
- B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional requirements of the specified product. A request for Architect/Engineer's approval must be submitted with complete technical data to allow for proper evaluation. All materials for evaluation must be received by Architect/Engineer at least 10 days prior to bid due date.

2.2 WIRELESS GATEWAY (WG)

- A. Wireless gateway(s) shall be capable of providing communication between a dedicated cloud server using TCP/IP and the on-site Programmable Thermostats using the IEEE 802.15.4 wireless communication protocol. Additional WGs can be used for a single site, but each WG must meet or exceed these requirements.
- B. The WG must provide the following hardware features as a minimum:
 1. Single Ethernet Port.
 2. One micro-USB 5VDC power input.

3. 2.4 GHz IEEE std. 802.15.4 built-in communication processor.
- C. The WG shall provide the communication link between the entire system and a cloud-based server. Communication with cloud server shall be secured using AES (Advanced Encryption Standard).
- D. The WG shall be able to support 2000 Programmable Thermostats.

2.3 PROGRAMMABLE THERMOSTAT (PT)

- A. Programmable Thermostat shall be a wireless communicating commercial programmable thermostat that uses IEEE 802.15.4 for networking communication and a wiring terminal block for controlling a single zone HVAC unit.
- B. The PT shall provide a keypad for setting:
 1. Temperature Set Points.
 2. System Mode (Heat, Cool, Auto, Off).
 3. Fan Mode (Auto, On).
 4. Light Button.
- C. The PT shall include a wiring terminal for controlling a single zone HVAC unit or a single zone damper actuator. The wiring terminal must be able to be removed from the PT for installations where only 3-wires exist or are available between where the PT will be placed and its connection with the equipment it will be controlling. The thermostat must be able to control the HVAC unit based on these specifications.
- D. The PT must be configurable using a Web Based App. No thermostat configuration, other than setting the PT to Conventional Fan Coil shall be done at the thermostat. Web based Configuration Setting options shall include:
 1. Naming the thermostat
 2. Grouping multiple thermostats
 3. System Type: Conventional Fan Coil, or Damper Actuator system setting
 4. Anticipation Degrees (0°F - 0.5°F)
 5. Calibration Degrees (2.0°F - -2.0°F)
 6. Heat Stages (0 - 2)
 7. Cool Stages (0 - 2)
 8. Fan Stages (1 - 2)
 9. Temperature Display (Fahrenheit)
 10. Heat Range Temperature Setting Limitation
 11. Cool Range Temperature Setting Limitation
 12. Ability to disable and enable Keypad Control through schedule
 13. Heat consumption (kw, btu, ton, or watt)
 14. Damper Type: Open/Close or Floating
 15. Reheat Type: Open/Close or Floating
 16. Cool consumption (kw, btu, ton, or watt)
 17. Notification Sensitivity (High, Medium, Low)
 18. Alarm of exceeding temperature based on a Safe Range
 19. Schedule set times (2, 3, 4, or Variable)

- E. PT settings and control through the Web Base App shall be in real-time and include:
 - 1. Space Temperature
 - 3. System Mode (Heat, Cool, Auto, Off).
 - 2. Fan Mode (Auto, On).
 - 3. Current set point.
 - 4. Relay status (Heat/Cool and Fan).
 - 5. Historical Trend Graphs.
 - 6. Scheduling.
 - 7. Lock and Unlock Entire Thermostat's Keypad.
 - 8. Lock and Unlock the Thermostat's Fan Mode setting Only.

2.4 WEB BASED GRAPHICAL USER INTERFACE

- A. The Web Based App (WBA) shall be able to run on any PC that uses Safari, Chrome, Firefox, or any other web browser that meets these browsers' functionality.
- B. The WBA Platform shall be able to run on any Internet Accessible Smartphone and/or Tablet that has a Web Browser compatible with HTML 5.
- C. The WBA shall not require any on-site servers or software to run to be usable by client.
- D. The WBA shall allow up to a minimum of 100 simultaneous users/clients to access the Direct Digital Control.
- E. The Web Based client shall support at a minimum, the following functions
 - 1. User log-on identification and password shall be required.
 - 2. HTML programming shall not be required to display any graphics or data on the Web page.
 - 3. Storage of data shall reside on cloud server and shall not sit within the client's computer or device. DDC that requires data storage on a client computer or on-site server is not acceptable.
 - 4. Users shall have administrator and user definable access privileges.
 - 5. OpenAPI interface with XML data output.
- F. Schedules
 - 1. The WBA shall provide user with access to setting Programmable Thermostat (PT) schedules. Up to 12 schedule periods per day shall be available for each PT.
 - 2. Schedules shall be available as Weekly (7-day), Daily, or Weekday/Weekend (5-2).
 - 3. The WBA shall provide the user the ability to:
 - a. View Schedules.
 - b. Add/Modify Schedules.
 - c. Assign Thermostat to a Group Schedule.
 - d. Delete Schedules.
 - e. Create Share Schedules.
 - f. Create Event Based Schedules.

G. Trending

1. The WBA shall provide real-time trend information on:
 - a. Each space temperature.
 - b. Each temperature set points.
 - c. Each current call: heat, cool, and/or fan.
 - d. Each call for economization.
 - e. Each damper position.
2. The WBA shall be able to record and provide at least two years of past trend data for every thermostat in the wireless network. Trend data shall include:
 - a. Space temperature, with resolution of every 1/10th of a degree Fahrenheit.
 - b. PT's temperature set points.
 - c. Indication of whether the thermostat was calling for heat, cool, and/or fan.
3. Trend data shall be viewable on the WBS

H. Alarm Notifications

1. The WBA shall provide automatic alarming functionally based on real-time monitoring of at least:
 - a. Space temperature and temperature change.
 - b. PT's temperature set points.
 - c. PT's current call: heat, cool, and/or fan.
2. The WBA shall be able to provide a user with the ability to:
 - a. View Alarms.
 - b. Set Alarm Notification sensitivity level to High, Medium, or Low.
 - c. Delete Alarms.
3. Alarms shall be able to be sent via email and/or text message to up to 100 or more clients.

I. Consumption Usage

1. The WBA shall be able to calculate and graphically display the consumption of running a single zone HVAC unit based on a user defined HVAC unit heat and/or cool consumption rate multiplied by the thermostat heat/cool call time.
2. The WBA shall be able to calculate and graphically display the cost of consumption of running a single zone HVAC unit based on taking a user defined HVAC unit heat and/or cool consumption and multiplying that by the client defined cost per kw and/or therm.
3. The WBA shall be able to display consumption usage for a single thermostat, multiple thermostats at a single time, or all the thermostats in the DDC.
4. The WBA shall be able to record and display up to at least two years of consumption usage information.

2.5 ENABLED ECONOMIZER (EE)

- A. EE shall use up to three 10K Type II external thermistor temperature sensor input.
- B. Web Based App shall be able to record and provide at least two years of past data for EE. Data must represent historical representations of:

1. Calls for Economization
 2. Outside Air Damper Position
 3. Supply and Outside Air Temperature
- C. The trend data shall be viewable on the WBA.
- D. EE must have a settable 0-10VDC output for Outside Air Damper Actuator control.
- E. EE must have a 0-10VDC input for Outside Air Damper Position Feedback.
- 2.6 ENABLED AIR HANDLER CONTROLLER (EAHC)
- A. The EAHC shall be able to wirelessly communicate with all Programmable Thermostat (TS) which are controlling a damper actuator that the EAHC is going to provide conditioned air too.
- B. TS that meets the above statement must send EAHC information on what type of conditioned air the zone requires and how much of this conditioned air will be required to properly condition the zone.
- C. EAHC must be able to accept information from TS and automatically calculate a supply air temperature target based on TS demand.
- D. EAHC must not run air conditioning when there is no air conditioning demand by a TS.
- E. EAHC must not run the air conditioning when there is reheat demand from a TS.
- F. EAHC must be able to provide Demand Control Ventilation if a TS has a CO2 sensor.
- G. No wire must be required between the EAHC and a zone damper or zone thermostat/sensor.
- H. The EAHC must be configurable using a Web Based App. No configuration shall be done at the EAHC. Web based Configuration Setting options shall include:
1. Name of the EAHC location.
 2. Description of what the EAHC is controlling.
 3. System Type: Conventional Fan Coil.
 4. Heat stages: 1-3.
 5. Cool stages: 1-3.
 6. Fan stages: 1, 2, or Variable
 7. Variable Speed Fan: Minimum Fan Speed
 8. Bypass Controller: Open damper position (VDC), Closed damper position (VDC)
 9. Static Pressure:
 - a. Target Operating Static: Static during a heating or cooling cycle
 - b. Target Circulation Static: Static during a ventilation cycle
 - c. Maximum Static: Low static safety for automatic reset
 - d. Maximum Static: High static safety for automatic reset
 10. Input Sensor: Supply Air Temperature
 11. Input Sensor: Return Air Temperature

12. Input Sensor: Outside Air Temperature

PART 3 - EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

A. General

1. Installation of the Direct Digital Control shall be performed by an approved manufacturer. The Contractor shall certify all work as proper and complete. Under no circumstances shall the design, installation, scheduling, coordination, programming, training, and warranty requirements for the project be delegated to a subcontractor without prior written approval of the owner.

B. Demolition

1. Remove controls which do not remain as part of the Direct Digital Control. The Owner will inform the Contractor of any equipment which is to be removed that will remain the property of the Owner. All other equipment which is removed will be disposed of by the Contractor.

C. Access to Site

1. Unless notified otherwise, entrance to building is restricted. No one will be permitted to enter the building unless their names have been cleared with the District or the District's Representative.

D. Code Compliance

1. All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations.

E. Cleanup

1. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract.

3.2 WIRING, CONDUIT, AND CABLE

- A. All control wires between HVAC units and thermostat locations to be furnished and installed by this contractor. The DDC contractor shall not begin work on this contract until all wiring is installed. The DDC contractor shall provide all wiring and conduit as required for a complete and operational system between remote temperature sensors, TA1 and thermostats as required, unless noted otherwise in drawings or specifications.

3.3 HARDWARE INSTALLATION

- A. Installation Practices for Devices.

1. All devices are to be mounted level/plumb and per the manufacturer's installation documentation.

B. Identification

1. Identify all control wires with labeling tape or sleeves using either words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
2. All field enclosures, other than controllers, shall be identified with a back lite nameplate. The lettering shall be in white against a black or blue background.
3. Junction box covers will be marked to indicate that they are a part of the DDC system.
4. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with name plates.
5. All I/O field devices inside FIP's shall be labeled.

C. Existing Controls

1. Existing controls are not to be reused. All DDC devices will be new.

D. Control System Switch-Over

1. The Contractor shall minimize control system downtime during switch-over. Sufficient installation mechanics will be on site so that the entire switch-over can be accomplished in a reasonable time frame.

E. Location

1. The location of sensors is per mechanical and architectural drawings.
2. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light, and diffuser air streams.
3. If any line voltage electrical control is being installed, field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.4 SYSTEM PROGRAMMING

A. General

1. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software.
2. Contractor shall work with owner's representative to determine programming parameters including but not limited to hours of operation, set points, system variables, thermostat naming, and site naming. Thermostat & Site naming shall be performed by the contractor. Naming convention (equipment # or name, or space served) shall be provided by or agreed upon with the Owner.

3.5 COMMISSIONING AND SYSTEM STARTUP

A. DDC device functional testing.

1. Each system for which an DDC device has been installed shall be tested for proper installation and functional operation. Test shall include on-site control test to verify each wireless device is responding to signals sent from cloud-based servers and responding in accordance with manufacture's specifications.

END OF SECTION 25 10 00

SECTION 25 11 00 - ELECTRICAL CONTROLS AND INTERLOCKS

PART 1 - GENERAL

1.1 Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.

1.2 RELATED WORK IN OTHER SECTIONS

260500 GENERAL ELECTRICAL PROVISIONS
260519 LOW VOLTAGE CONDUCTORS
260526 GROUNDING
260533 RACEWAYS, BOXES, AND FITTINGS
262726 WIRING DEVICES AND PLATES
262900 MOTOR STARTERS

1.3 DESCRIPTION OF WORK

- A. All disconnect means, motor controllers, electrical controls, protective, and signal devices for equipment furnished under Division 25 of these specifications will be installed and connected as scheduled herein or as otherwise noted on the drawings.
- B. Electrical items not shown on the electrical drawings, but which are required for equipment furnished under Division 25 of this specification shall be furnished under this section of the specifications and shall be installed and electrically connected in conformance with Division 26 Specifications.

1.4 SUBMITTALS

- A. Submittal data for each individual electrically controlled item of equipment or device furnished under this Division of these specifications shall include complete electrical wiring diagrams, and elementary control diagrams (ladder form) showing all internal and external wiring connections and services. The submittal data shall itemize all electrical characteristics that are of a special nature or critical to the electrical installation or control system. Such equipment and devices will not be considered for approval until these requirements are met. These submittals shall form a part Section 250500 requirements and shall be properly coordinated by the Contractor.
- B. As soon as possible after contract notice to proceed, one print of the ladder diagrams shall be submitted by the contractor showing all necessary wiring for the mechanical equipment and devices proposed for installation. This print shall be reviewed and approved by the contractor, and then submitted to the Architect/Engineer for approval. The print shall indicate all components which shall be wired to the control/power circuits by the contractor, with all terminals for external connections of the components identified and labeled to correspond to the manufacturer's designations. Internal or factory installed wiring of package-type components need not be shown. Control diagrams shall show all internal and external wiring connection and shall clearly indicate field wiring furnished and installed under Division 25, differentiated from field wiring furnished and installed under Division 26.

- C. Revised Drawings: After the Architect/Engineer has approved the marked copy of the control diagrams submitted in accordance with Paragraph B above, the Contractor shall issue prints to all involved parties. The control diagrams shall be certified in writing as being acceptable to the contractor. The approved drawings will then be included in the control submittal and the Operating and Maintenance Manual.

1.5 INSTALLATION

- A. No control work shall be performed until control submittal has been approved by the Architect/Engineer.

1.6 CHANGES DURING CONSTRUCTION

- A. The complete responsibility and costs for revisions during construction to the approved control diagrams, and the resultant changes to the installation requirements, not covered by contract change order, shall be assigned to the contractor requesting such revisions.

PART 2 - PRODUCTS

2.1 CONTROL AND INTERPOSING RELAYS

- A. Relays other than those on I/O cards shall be general purpose, enclosed plug-in type with 8 pin octal plug and protected by a heat and shock resistant dust cover. Relays shall be of the Neon or LED indicator type.
- B. Relay contact configuration and ratings shall be for rated load voltage and exceed load current rating by no less than fifty percent. Minimum contact rating shall be 10 amps at 120 volts AC.

2.2 TERMINAL STRIPS

- A. Terminal strips shall be of the molded nylon or polypropylene barrier type, individual plug-in mounted on a mounting channel. Terminal connections shall be rated 300 volt, 40 amp and shall be of the tubular clamp type for use with bare wire ends, or of the strap screw type for use with crimp spade lug prepared wire ends. Terminal strips shall provide for removable marking strips or have prepainted matte finish marking surfaces. Buchanan 600 series or approved substitute.

PART 3 - EXECUTION

3.1 RELAYS

- A. All remote field devices shall be controlled through the use of an interposing relay. In no case shall a contactor or motor starter be directly controlled from a solid state device output or relay contact of a rating less than that stated above.

3.2 COMPONENT IDENTIFICATION

- A. All individual components (relays, timers, terminal strips, etc.) shall be clearly marked with the identification nomenclature shown on the manufacturer's shop drawings.

Identification shall be by the use of press-type tape strip (kroy) covered with Scotch 600 clear tape or approved substitute method.

3.3 CONTROL WIRING INSTALLATION

- A. The installation and wiring of all electrical equipment installed under this contract shall meet all Electrical Division specifications. Special attention is called to the following:
1. All wiring to be in conduit.
 2. All control wiring to be color-coded throughout. Conductor color shall be consistent for the entire length of circuit.
 3. All splices shall be made in junction boxes on terminal strips.
 4. All control wiring to terminate on marked terminal strips and shall be marked at all terminal points. Both ends of each wire shall be marked with a designation shown on the manufacturer's shop drawings, using interlocking chevron shaped snap-on plastic markers, hot-marked shrinkable tubing, hot stamping of the wire, or clear shrink-on tubing securing adhesive labels. Markers which depend solely on adhesive are not acceptable.

END OF SECTION 25 11 00

SECTION 25 30 00 - CONTROLS AND INSTRUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install a control system, complete in all respects to provide the Sequence of Control shown on the drawings.
- B. All disconnect means, motor controllers, and all protective and signal devices for all electrical equipment provided under all Electrical Divisions will be furnished, installed, and connected under all Electrical Divisions with the following exceptions:
 - 1. All controls wiring and conduit for HVAC equipment is the complete responsibility of all Mechanical Divisions. Electrical connections, relays, interlocks, etc. not shown on the electrical drawings, but which are required for equipment furnished under all Mechanical Divisions shall be installed and electrically connected by all Mechanical Divisions in conformance with all Electrical Division Specifications.
 - 2. All disconnect means, motor controllers, and all protective and signal devices furnished with, mounted on, and connected integral with equipment furnished under other divisions.
 - 3. All disconnect means, motor controllers, electrical controls, protective, and signal devices for equipment furnished under all Mechanical Divisions of these specifications will be installed and connected as scheduled herein or as otherwise noted on the drawings.
- C. The mechanical trade is entirely responsible for furnishing, installing, wiring, connecting, and placing the control systems in operation. Electrical work required will be the final responsibility of the Mechanical Contractor either by his own electricians or by his subcontract with an Electrical Contractor.

1.3 RELATED WORK IN OTHER SECTIONS

230593 BALANCING OF MECHANICAL SYSTEMS
250000 INTEGRATED AUTOMATION INDEX
250500 GENERAL INTEGRATED AUTOMATION REQUIREMENTS

1.4 GENERAL REQUIREMENTS

- A. The control system shall be furnished complete for the heating and air conditioning systems by Pelican or prior approved equal. The temperature control company shall have a permanent, fully staffed, well-established, local office and service organization. A complete stock of all repair and replacement parts for all items furnished under this contract shall be carried in stock at the local office at all times.

- B. Submittals: Shall include plan size drawings, with individual literature on each item, showing control sequences, complete electrical ladder diagrams and all control components and their wiring requirements. The Contractor shall be responsible to see that all systems are properly coordinated.
- C. Operation and Maintenance Manuals: As soon as possible after Award of Contract, the Contractor shall prepare an Operation and Maintenance (O & M) Manual and submit it to the Engineer for review and approval. The control system testing, and training specified hereafter shall not be conducted until the O & M Manual has been approved. See Specification Section 251000 – DIRECT DIGITAL CONTROL SOFTWARE AND COMPONENTS. The Manual shall contain, as a minimum:
 - 1. Approved control diagrams.
 - 2. Equipment and device catalog cuts identifying each control device with a unique number or symbol coordinated with the control diagram symbols.
 - 3. A Sequence of Control for each system's control diagram identifying the function and physical location of each adjustable control device, written in language understandable to personnel not specifically trained in HVAC control systems.
 - 4. A Troubleshooting section for each control system indicating what tests and/or adjustments can be made to identify and/or correct common problems with control systems of the type installed. This description should address procedures to determine the cause of high or low space temperature and/or humidity in a typical room served by each air handling system. The description should be adequate to lead untrained persons to conclude, at minimum, whether the unit is receiving adequate primary cooling or heating, whether mixed air and supply air temperatures are reasonable and whether field adjustments or technical service is required to solve the problem. This troubleshooting section shall be bound in a separate section of O & M Manual and shall clearly refer to control device symbols shown on the Control Diagram drawings.

1.5 SPECIAL REQUIREMENTS

- A. The controls trade shall check and adjust his control system completely, four (4) times during the warranty period. The fourth (4) check to be made during the final thirty days of the warranty period.
- B. The controls trade will furnish the Owner with an accurate, up-to-date wiring diagram of all electrical and electronic equipment installed under this contract.
- C. The Contractor shall furnish a complete set of parts lists, operating instructions, and maintenance literature, in duplicate, for proper maintenance of all control equipment.
- D. Steel lockable covers shall be provided for all space thermostats where shown on the drawings and where the space thermostat could be damaged.

PART 2 - PRODUCTS

2.1 CONTROL AND INTERPOSING RELAYS

- A. Relays other than those on I/O cards shall be general purpose, enclosed plug-in type with 8 pin octal plug and protected by a heat and shock resistant dust cover. Relays shall be of the Neon or LED indicator type.
- B. Relay contact configuration and ratings shall be for rated load voltage and exceed load current rating by no less than fifty percent. Minimum contact rating shall be 10 amps at 120 volts AC.

2.2 TERMINAL STRIPS

- A. Terminal strips shall be individual plug-in type on a mounting channel. Terminal connections shall be rated 300-volt, 40 amp and shall be of the tubular clamp type for use with bare wire ends, or of the strap screw type for use with crimp spade lug prepared wire ends. Buchanan 600 series or approved substitute.

2.3 AUTOMATIC DAMPERS

- A. All automatic dampers shall be furnished by the controls trade and shall be constructed of galvanized sheet steel with bushings made of oil impregnated sintered bronze to give constant lubrication. Each damper section shall have positive closing neoprene blade and edge seals. Outside air, return air and relief dampers shall have blades designed so that the blades are interconnected to give parallel movement. Each modulating damper shall provide a near linear relationship between damper opening and airflow. All volume dampers shall have opposed blades, which will produce equal pressure drop flow characteristics. Blade width shall not exceed 6 inches.

2.4 AUTOMATIC CONTROL VALVES - ELECTRIC

- A. The controls trade shall provide all automatic control valves and shall be made by the control manufacturer. All electric control valves 2" and smaller in size shall be brass body and trim, 2-1/2" and larger shall be iron body with brass or stainless-steel trim. Valves shall be provided with renewable type seats and adjustable springs. Valves shall be designed to pass the quantity of water and with a maximum pressure loss not to exceed 10 ft. Valves shall be provided with "V" port or throttling type seat. Valves 2" or smaller shall be screwed. Valves 2-1/2" and larger shall be flanged. All sequencing valves shall have positive positioners.

2.5 DAMPER MOTORS - ELECTRIC

- A. The damper motor shall be electro-hydraulic type capable of providing full proportional control of dampers. The actuator shall be compatible with any low voltage controller or auxiliary device. One motor shall be provided per damper section.

2.6 CONTROL PANELS

- A. An enclosed control panel or panels with hinged door and locking device shall be installed where shown on the drawings. Panel layout shall be as shown. Thermometers switches and pilot lights will be flush mounted on the hinged door. Hard tubing shall be brought into the panel. Tubing within the panel may be plastic neatly bundled and tagged. All indicators and controllers will have descriptive bakelite tags.

2.7 FILTER GAUGES

- A. Shall be furnished and installed in each filter bank located in the Mechanical Room and at each rooftop air handling unit. Gauges shall be Dwyer Magnahelic with static pressure tips and interconnecting tubing. Range shall be approximately 1-1/2 times the nominal filter change out pressure differential. Each rooftop filter bank shall also have a differential pressure switch with indicator lamp located on a control panel in the Mechanical Room to indicate filter replacement pressure differential has been exceeded.

2.8 SMOKE AND FIRE DETECTORS

- A. Smoke detectors shall be furnished and installed in each air handling unit or system and detectors shall be furnished by the Division 26 Contractor, installed by the Division 25 Contractor, connected, and tested by the Division 26 Contractor.

2.9 SEQUENCE OF OPERATION

- A. The operation of the control system shall be as indicated on the drawings and control diagrams. The sequence shall be rewritten and shown on the control submittal drawing diagramming that system. The sequence on the submittal drawing shall identify control devices by number and physical location coordinated with the submittal drawing device numbers.

PART 3 - EXECUTION

3.1 RELAYS

- A. All remote field devices shall be controlled through the use of an interposing relay.

3.2 INSTALLATION

- A. No control work shall be performed until the control system shop drawings have been approved by the Engineer and returned to the contractor.

3.3 CONTROL WIRING

- A. The installation and wiring of all electrical equipment installed under this contract shall meet all Division 16 specifications. Special attention is called to the following:
 - 1. All wiring to be in conduit.
 - 2. All control wiring to be color-coded throughout. Conductor color shall be consistent for the entire length of circuit.

3. All splices shall be made in junction boxes on terminal strips.
 4. All control wiring to terminate on marked terminal strips and shall be marked at all terminal points. Both ends of each wire shall be marked with a designation shown on the manufacturer's shop drawings, using interlocking chevron shaped snap-on plastic markers, hot-marked shrinkable tubing, hot stamping of the wire, or clear shrink-on tubing securing adhesive labels. Markers which depend solely on adhesive are not acceptable.
- B. Terminal strips shall be used in all boxes and cabinets where more than six control wires are terminated, spliced or both.
- C. All control wiring shall be color coded and marked in each box, at each termination with Brady wrap around labels or suitable tags approved by the Architect. The schematic control diagrams shown on the contract drawings are for the convenience of the contractor and may not be complete in all details of control wiring for the equipment purchased for installation.

3.4 SYSTEM TESTING

- A. The integrity and accuracy of each function and control point shall be demonstrated to the satisfaction of the Architect/Engineer during the test period. At the termination of the testing period the Contractor shall spend one working day instructing the Owner or his designated personnel in the control system operation. A complete operating booklet shall be provided and used during the training period.
- B. Upon completion of the installation, the Contractor or his authorized representative shall be sent to the installation to certify that all necessary electrical tests and control adjustments have been completed. He shall then file a letter of Certification indicating that the system functions and conforms to the intent of these specifications.

END OF SECTION 25 30 00

SECTION 25 60 00 - MECHANICAL AND ELECTRICAL COORDINATION SCHEDULE

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.
- B. It is the responsibility of the Contractor to carefully coordinate all trades to provide a complete and operational system that conforms to the contract documents.

1.2 DEFINITIONS

- A. “Furnished by” shall mean that the materials, equipment, wiring, etc. shall be provided to the project by the noted contractor unless specifically noted otherwise in the contract documents.
- B. “Install by” shall mean that the materials, equipment, wiring, labor, etc. shall be installed (mounted in field) at coordinated locations for complete system and shall be completed by the noted contractor unless specifically noted otherwise in the contract documents.
- C. “Control wiring” shall mean that the controls wiring including all supports, connections, etc. shall be installed complete by Contractor noted unless specifically noted otherwise in the contract documents.
- D. “Power wiring” shall mean that the power wiring including all supports, connections, circuits, etc. shall be installed complete by the Contractor noted unless specifically noted otherwise in the contract documents.
- E. “Connected by” shall mean that all required materials and labor shall be provided to and for the complete installation of all devices and equipment and shall be completed by the noted contractor unless specifically noted otherwise on the contract documents.

- 1.3 SCOPE: Make all connections to motors and controls for equipment furnished and/or installed under Mechanical and Electrical Specifications according to the following schedule unless otherwise noted on the contract documents:

Item	Furnished By	Installed By	Control Wiring By	Power Wiring By	Connected By
Fire/Smoke Dampers	Div. 23	Div. 23			
Fire/Smoke Dampers Linkages	Div. 23	Div. 23			
Fire/Smoke Dampers Actuators/Smoke Detectors	Div. 23	Div. 23	Div. 28 (d)	Div. 28 (e)	Div. 28 (d)
Fire Alarm Panel and Interfacing with A/C Systems	Div. 28 (d)	Div. 28 (d)	Div. 28 (d)	Div. 28 (d)	Div. 28 (d)
Hydronic Valves	Div. 25	Div. 25			
Hydronic Valves Actuators	Div. 25	Div. 25	Div. 25	Div. 26(e)	Div. 25

Item	Furnished By	Installed By	Control Wiring By	Power Wiring By	Connected By
Flow Control Regulators	Div. 25	Div. 25	Div. 25	Div. 26(e)	Div. 25
Duct Smoke Detectors	Div. 25	Div. 25	Div. 28 (d)	Div. 26 (d)	Div. 28 (d)
Volume Control Dampers	Div. 23	Div. 23			
Volume Control Dampers Linkages	Div. 23	Div. 23			
Volume Control Dampers Actuators	Div. 23	Div. 23	Div. 23		Div. 23
120V Thermostat Backboxes & Wall Conduit	Div. 26	Div. 26			
DDC Electronic Thermostats	Div. 25	Div. 25	Div. 25		Div. 25
DDC Terminal Controls	Div. 25	Div. 25	Div. 25	Div. 26 (b)	Div. 25
DDC Zone Control Panels	Div. 25	Div. 25	Div. 25	Div. 26 (b)	Div. 25
DDC Backboxes and Cabinets	Div. 25	Div. 16			
Non-DDC Control Relays	Div. 25	Div. 25	Div. 26	Div. 25	Div. 25
Non-DDC Thermostats, Time	Div. 25	Div. 25	Div. 26	Div. 25	Div. 25
Non-DDC Control Transformers	Div. 25	Div. 25	Div. 25	Div. 26 (e)	Div. 25
HVAC Instrumentation (electronic temperature sensors, etc.)	Div. 25	Div. 25	Div. 25	Div. 26 (e)	Div. 25
Equipment Motors	Div. 23	Div. 23	Div. 26	Div. 26	Div. 26
Motor Starters & Overload Heaters Outside Motor Control Centers	Div. 26	Div. 26	Div. 26	Div. 26	Div. 26
Fused & Unfused Disconnect Switches Thermal Overload & Heaters	Div. 26	Div. 26	Div. 26	Div. 26	Div. 26
Manual Operating & Multispeed Switches (Low Voltage – Less than Line Voltage)	Div. 26	Div. 26	Div. 26	Div. 26	Div. 26
Pushbutton Stations & Pilot Lights	Div. 26	Div. 26	Div. 25	Div. 26	Div. 26
Fire Protection Sprinkler System Control Supervisory Panels and Devices O.S.O.&Y. Switch, Flow Switch	Div. 21	Div. 21	Div. 28 (d)	Div. 26	Div. 28 (d)
Heat Taping for Mechanical Systems	Div. 23	Div. 23	Div. 23	Div. 26 (e)	Div. 26 (e)
Variable Frequency Drives	Div. 23	Div. 26	Div. 23	Div. 26	Div. 26

Table Notes:

- a) Unless specified to be furnished under Division 25 by the equipment supplier.
- b) A dedicated isolated power circuit to Direct Digital Controls (DDC) Central Control Station shall be furnished and installed under Division 26.
- c) Smoke damper EP's and pneumatic actuators shall be wired into the fire alarm system Division 28.
- d) Performed by the Fire Alarm Sub-Contractor Division 28
- e) 120V connections by Div. 26

1.4 SUBSTITUTIONS: If the substitution of equipment, devices, or systems furnished under this Division result in changes to the Contract Drawings, Specifications and/or changes to the installation requirements, the complete responsibility and costs shall be assigned to the section of

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these Specifications under which the equipment is furnished with no additional costs to the Owner.

- 1.5 SUBMITTALS: In conjunction with the temperature control, Fire Extinguishing System, and DDC submittals, complete submittal data for each individual Electrically operated or Electrically controlled item of equipment or device furnished under this Division of these Specifications shall include Electrical wiring diagrams and elementary control diagrams (ladder form) showing all internal and external wiring connections and services and shall clearly indicate field wiring furnished and installed under Division 25, differentiated from field wiring furnished and installed under Division 26. The submittal data shall itemize all Electrical characteristics that are of a special nature or critical to the Electrical installation or control system. Such equipment and devices will not be considered for approval until these requirements are met. All submittal data shall be reviewed and approved by the General Contractor, Mechanical, Electrical and Controls Sub-Contractors prior to submission of the complete Temperature Control, Fire Extinguishing System and DDC submittal to the Architect. The submittals shall indicate all components that are to be wired into the control power circuit by the Electrical Sub-Contractor, with all terminals for external connections of the components identified and labeled to correspond to the manufacturer's designations. Internal or factory installed wiring of package-type components need not be shown. The Shop Drawings for the system to be installed by the Temperature Controls, Fire Extinguishing System and DDC Sub-Contractors shall be prepared as complete submittals including all wiring requirements as described herein. Color coding designations shall be indicated for the control power circuit wiring.

PART 2 - PRODUCTS

- 2.1 REQUIREMENTS: The materials, equipment, and devices related to the Electrical System controls are specified under other sections of these Specifications.

PART 3 - EXECUTION

3.1 CHANGES DURING CONSTRUCTION

- A. The complete responsibility and costs for revision during construction arising as a result of equipment substitutions, and any resultant changes to the installation requirements, shall be assigned to the respective section of these Specifications, under which the equipment is furnished at no additional costs to the Owner.
- B. In the event of conflict in the delineation of responsibilities for the furnishing and installation of items of Mechanical equipment and the associated control and interlock wiring between Division 26, Division 25 shall provide all required material, labor, etc., to complete the work as shown in the contract documents.

- 3.2 INSTALLATION: No control work shall be performed until the reviewed and marked submittal data have been reissued to the Contractor unless written permission is obtained from the Architect.

END OF SECTION 25 60 00

SECTION 26 00 00 - ELECTRICAL INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Electrical Work, as indicated on the Drawings, and specified herein. Electrical work indicated on the Drawings and/or specifications covering other trades shall conform to Division 26 of these Specifications.
- B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Electrical systems, shall be accomplished without additional cost to the Owner.
- C. Furnish all labor and materials required for electrical service and control connections to all the various items of equipment requiring electric or wiring service throughout the project shown on the Contract Drawings (even if not shown on the Electrical Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 ELECTRICAL DIVISION INDEX

260500 GENERAL ELECTRICAL PROVISIONS
260513 MEDIUM VOLTAGE CONDUCTORS
260519 LOW VOLTAGE CONDUCTORS
260526 GROUNDING
260533 RACEWAYS, BOXES, AND FITTINGS
260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS
261200 MEDIUM VOLTAGE TRANSFORMERS
262200 LOW VOLTAGE TRANSFORMERS
262416 PANELBOARDS
262716 CABINETS
262726 WIRING DEVICES AND PLATES
262800 MOTOR AND CIRCUIT DISCONNECTS
262900 MOTOR STARTERS
264300 SURGE SUPPRESSION PROTECTION DEVICES
265119 LED INTERIOR LIGHTING

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 26 00 00

SECTION 26 05 00 - GENERAL ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

- A. Regulatory Agencies: Installation, materials, equipment, and workmanship shall conform to the applicable provisions of the National Electrical Code (NEC), the National Electrical Safety Code (NESC), Occupational Safety and Health Act (OSHA) all local, state and national codes, ordinances and regulations governing the particular class of work involved and the terms and conditions of the electrical utility and other authorities having lawful jurisdiction pertaining to the work required. All modifications required by these codes, rules, regulations, and authorities shall be made by the Contractor without additional charge to the Owner. The Contractor shall secure all permits and licenses required for his work and shall pay all fees in connection with such permits and licenses.
- B. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved; and, on completion of the work, the Contractor shall obtain and deliver to the Owner, final certificates of acceptance. The Contractor shall furnish copies of each certificate to the Architect/Engineer.
- C. Underwriter's Laboratories (UL): All materials, appliances, equipment, or devices shall conform to the applicable standards of Underwriter's Laboratories, Inc. where such standards have been established.
- D. Standards: The current edition of the following specifications and standards shall form a part of these specifications:
 - 1. National Fire Protection Association Standards
 - 2. National Electrical Code, NFPA 70 (NEC)
 - 3. Life Safety Code, NFPA 101
 - 4. NFPA 72
 - 5. Occupational Safety and Health Act (OSHA)
 - 6. National Electrical Safety Code (NESC)
 - 7. Underwriter's Laboratories, Inc. (Standards)
 - 8. American National Standards Institute (ANSI)
 - 9. American Society of Testing and Materials (ASTM)
 - 10. Institute of Electrical and Electronic Engineers (IEEE)
 - 11. Insulated Cable Engineer's Association (ICEA)
 - 12. National Electrical Manufacturer's Association (NEMA)
 - 13. Americans with disabilities Act Accessibility Guidelines (ADA)

1.3 DRAWINGS

- A. The electrical drawings show the general arrangement of all conduit, outlets, equipment, etc. and shall be followed as closely as actual building construction and the work of other trades will permit. The architectural and structural drawings shall be considered as a part of the work insofar as these drawings furnish the Contractor with information relating to the design and construction of the building. Architectural drawings shall take precedence over electrical drawings. Because of the small scale of the electrical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, elbow, pullboxes, and accessories as may be required to meet such conditions.
- B. The Contractor shall verify the dimensions governing the electrical work at the building. No extra compensation shall be claimed or allowed because of differences between actual dimensions and those indicated on the drawings.
- C. Drawings and specifications shall be considered as complementary. Work or materials called for by one and not mentioned in other shall be provided as though treated by both.
- D. In the case of conflict between drawings and specifications, the greater or more restrictive requirement shall apply.
- E. Any question as to the intent of the drawings or specifications shall be referred to the Architect/Engineer, whose decision shall be final and conclusive.
- F. Should the Contractor observe any conflict or variation in the plans and specifications, he shall notify the Architect/Engineer in writing no later than seven (7) days prior to date of bid opening. Failure to clarify such variations will result in the Contractor bearing all costs arising from electrical work necessary to resolve the conflict or variation.

1.4 SERVICES

- A. General: Requirements of the serving power and telephone utilities and availability of services have been determined as accurately as possible. The Contractor shall verify availability of services and determine actual details pertaining to the exact locations and requirements of utilities before submitting bid. No consideration for extra cost will be given resulting from failure to comply with these requirements by the Contractor. Contractor shall immediately notify the serving utilities that he has the job, and also furnish information as to the total lighting and power loads for the job. He shall also furnish, at the same time, information as to the established completion date of the job.
- B. Telephone: Contractor shall immediately notify the serving utility of the estimated date when service will be desired.

1.5 AS-BUILT DRAWINGS

- A. During progress of the work, the contractor shall maintain an accurate record of the installation of the system, locating each outlet, and note all circuiting deviations from the

contract drawings. Upon completion of the installation, the contractor shall transfer all record data to a single neat and legible set of blue line prints of the original drawings.

1.6 OPERATING INSTRUCTIONS AND MANUALS

- A. Instructions: Without additional charge to the Owner, furnish competent instruction to the Owner in the care, adjustment, and operation of all parts of the electrical equipment and systems.
- B. Manuals: Upon completion of the work, prepare and deliver to the Owner two (2) sets of complete operating and maintenance manuals for the systems and major equipment installed, suitably bound in book form and must be originals. Include catalog data, shop drawings, wiring diagrams, performance curves and rating data, spare parts lists and manufacturer's operating and maintenance data.
- C. Other: The above requirements are in addition to specific instructions and manuals specified for individual systems or equipment.

1.7 SITE VISIT

- A. The Contractor shall visit the site prior to bidding and satisfy himself as to the conditions under which the systems are to be installed. No subsequent allowance shall be made in his behalf for failure to make such a visit.

1.8 FIELD MEASUREMENTS

- A. The Contractor shall verify the dimensions covering the work. No extra compensation shall be claimed or allowed due to difference between actual dimensions and those indicated on the drawings. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting the work.

1.9 PERFORMANCE TESTS

- A. Thoroughly test all fixtures, batteries, services, and all circuits for proper operating condition, required durations and freedom from grounds and short circuits before acceptance is requested. All equipment, appliances and devices shall be operated under load conditions.
- B. After the interior wiring system installation is complete and at such time as the Architect/Engineer may direct, conduct operating tests for approval. When requested, test all the wire, cable, devices, and equipment after installation, to assure that all material continues to possess all the original characteristics as required by governing codes and standards listed in these specifications.
- C. After occupancy of the building has taken place and nominal building power loads established, make voltage readings at all panelboards. Based on these readings, make final adjustments of taps on all transformers in the building as directed.

- D. Perform such other tests as required by other sections of these specifications or as requested to prove acceptability.
- E. Furnish all instruments and labor for testing.

1.10 REMODELING WORK

- A. Where remodeling work is indicated, the Contractor shall be responsible for all electrical work associated with changes in, or removals of existing walls, ceilings, or floors. This work shall include rerouting of conduits, relocation of fixtures, devices, and conduits as well as provision for circuit continuity for circuits in remodeled areas. The cost of all of this work shall be included in the Contractor's price with no additional compensation allowed for failure to include this work.

1.11 MISCELLANEOUS ITEMS

- A. Miscellaneous items not covered in these specifications shall be as indicated on the drawings, installed, and connected in the proper manner and as recommended by the manufacturer.

1.12 GUARANTEE

- A. All equipment and workmanship to be furnished under this contract shall be guaranteed for a period of one year from the date of final acceptance thereof against defective materials, design, and workmanship. Upon receipt of notice from the Owner of failure of any part of the guaranteed equipment during the guarantee period, the affected part or parts shall be replaced promptly with new parts by and at the expense of the Contractor. The labor incident to the installation of these replacements shall be furnished by the Contractor.

1.13 STANDARDS OF MATERIAL AND WORKMANSHIP

- A. All material shall be new and shall bear the label of the Underwriter's Laboratories, Inc., or be listed under re-examination service. All material shall be of the best grade and latest pattern of manufacture as specified. All work shall be performed in a neat, workmanlike manner and shall present a neat mechanical appearance when completed.

PART 2 - PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

- A. The electrical requirements for equipment specified or indicated on the drawings are based on information available at the time of design. If equipment furnished for installation has electrical requirements other than indicated on the electrical drawings, the Contractor shall make all adjustments to wire and conduit size, controls, overcurrent protection and installation as required to accommodate the equipment supplied, without additional charge to the Owner. The complete responsibility and costs for such adjustments shall be assigned to the respective section of this specification under which the equipment is furnished.

2.2 MATERIALS

- A. When the product of a specific manufacturer is indicated on the drawings or specified herein by catalog number or trade name, it has been done for convenience in fixing the standard for workmanship, finish, design, and the guaranteed performance. Any material, apparatus, or appliance which the Contractor desires to substitute for those mentioned herein shall also conform to these standards or exceed them and shall follow the procedure as outlined under substitutions and specified herein.
- B. All similar materials and equipment shall be the product of the same manufacturer.
- C. Where no specific material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be used, providing it conforms to the contract requirements and meets the approval of the Architect/Engineer.
- D. Materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such material and shall be the manufacturer's current and standard design.
- E. Altitude: Equipment affected by altitude shall perform satisfactorily for the function intended at the altitude of the project site.

2.3 NAMEPLATES

- A. All items of mechanical and electrical equipment shall be identified by the attachment of engraved nameplates, constructed from laminated phenolic plastic, at least 1/16" thick, three-ply, black surface and white core. Plates shall be attached using stainless plate screws unless indicated otherwise. Nomenclature on the label shall include the name of the item and feeder circuit number. Equipment to be labeled shall include, but not be limited to, the following:
 - 1. Air Conditioning Control
 - 2. Contactors
 - 3. Panels and Switches
 - 4. Time Switches
 - 5. Relays
 - 6. Disconnect Switches
 - 7. Starters
 - 8. Transformers
 - 9. Miscellaneous
 - 10. Similar and/or related items

2.4 IDENTIFICATION AND SIGNS

- A. Label each individual motor controller, disconnect switch, transformer, and remote-control device to identify each item and its respective service.
- B. Provide nameplates with engraved lettering not less than 3/8 inch high where specified or noted. In general, use white core laminated plastic, attached with screws. Embossed

plastic adhesive tape is not acceptable. Flush mounted devices may have identification engraved in the device plate.

- C. Provide warning signs on all equipment or devices operating at 300 volts or more, reading "DANGER - 480 VOLTS" (insert respective voltage) etc., with white letters on red background of standard code size. Signs may be decals, stencils, or nameplates.
- D. Identify panelboards and cabinets by nameplates with descriptions indicated on the drawings together with voltage and phase. Install on outside of hinged doors of panelboards and cabinets.

2.5 CHANGES

- A. No changes shall be made in the electrical work as shown and herein specified, unless such changes are authorized in writing by the Architect/Engineer and such authorization shall contain a statement covering the amount of the charges involved in the change.

2.6 SUBSTITUTIONS

- A. On all material, substitutions will be considered only if requested by letter from the Contractor to the Architect/Engineer. Letters must be in the engineer's office no later than 10 days prior to the bid date and shall be considered as authorized only upon written confirmation from the Architect/Engineer. Where materials are proposed to be substituted in lieu of the items specified, substitutions shall be equal in quality, workmanship and design. The burden of proof of equality of materials shall be placed upon the Contractor. Samples of all materials proposed for substitution shall be submitted to the Architect/Engineer, when requested, for examination.

2.7 SHOP DRAWINGS

- A. Shop drawings shall be furnished for all equipment and materials. They shall be furnished by the Contractor as required in the Submittal Section. Where equipment will be furnished "as specified," a statement to that effect is sufficient. Where substitutions are proposed, complete data must be furnished showing performance, quality and dimensions.
- B. The Contractor shall submit to the Architect/Engineer for checking a complete descriptive and technical data list for all items of material furnished under this contract. Complete outlines, dimensions, electrical services, control diagrams, electrical characteristics of special nature or critical to the installation and pertinent data required for installation shall be shown. Fixture submittals shall include scale drawings showing metal gauges and finish together with complete photometric distribution curves and coefficient of utilization tables. Glare factor curves shall also be submitted for each fixture. Failure to submit this information can be the basis for disapproval.
- C. All descriptive and technical data and shop drawings shall bear signed certification that they have been carefully examined and found to be correct with respect to dimension, space available, non-interference with other trades and that the equipment complies with all the requirements of these specifications. Submittals that have not been checked for compliance will not be considered by the Engineer.

- D. Only complete submittals will be considered, partial submittals will not be reviewed.

2.8 SUBMITTALS

- A. Submittals shall be complete; bound booklets with an index of all items submitted including associated catalog/part numbers. The Contractor shall make submittals on all the following equipment (in addition to any special items indicated elsewhere in the plans or specifications):
1. Lighting Fixtures
 2. Wiring devices
 3. Conduit
 4. Wire
 5. Panelboards
 6. Switchgear
 7. Fuses
 8. Metering equipment
 9. Transformers
 10. Starters
 11. Contactors
 12. Disconnect switches
 13. Motor Control Centers
 14. Lamps
 15. Dimming systems
 16. Special Systems equipment (Fire Alarm, Intrusion Alarm, Sound, TV, Lightning Protection, etc.).
- B. Electrical System Controls: Refer to Section 253000 for additional submittal requirements.
- C. After receiving approval on the make and the type of materials, the Contractor shall order such materials in sufficient time to prevent any delay or changes on the job.

PART 3 - EXECUTION

3.1 GENERAL

- A. Fabrication, erection, and installation of the complete electrical system shall be done in a first-class workmanlike manner by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project. The Contractor shall check all areas and surfaces where electrical equipment material is to be installed, removed, or relocated and report any unsatisfactory conditions before starting work. Commencement of work signifies the Contractor's acceptance of existing conditions. In the acceptance or rejection of the finished installation, no allowance will be made for lack of skill on the part of workmen.

3.2 EQUIPMENT

- A. Equipment and materials furnished by the Contractor shall fit the spaces allocated for them. Should the equipment which the Contractor proposes to install, require space

conditions other than indicated on the drawings, it shall be the Contractor's responsibility to reconcile the available space with the equipment and make any changes required to accommodate the equipment. All required changes shall be made at the Contractor's expense.

- B. All equipment, both the Contractor and Owner furnished, shall be installed in accordance with the manufacturer's recommendations.

3.3 COORDINATION

- A. The Electrical Plans are diagrammatic but shall be followed as closely as actual construction and the work of other trades will allow. Such minor changes as are necessary to make the electrical work conform to the work of other trades and to the building shall be made without cost to the Owner.

3.4 CIRCUITS AND FEEDERS

- A. Circuits and feeders shall be as shown and no deviations from the indicated outlet-circuit grouping will be permitted, except by permission of the Architect/Engineer. Branch circuit numbers are mandatory and shall be changed only on written permission from the Architect/Engineer. Any changes in layout or circuit numbering shall be accurately recorded on the "As-Built" drawings.

3.5 CONDUITS

- A. In all spaces, such as ceiling spaces and equipment rooms, all conduits shall be run to a continuous grade and square to the building.
- B. The plans do not give exact details as to the elevations of conduits, exact locations, etc., and do not show all off-sets, bends, junction boxes and other installation details. The Contractor shall carefully lay out his work at the site to conform to details of installation.

3.6 LOCATION OF EQUIPMENT AND OUTLETS

- A. The approximate locations of cabinets, panelboards, wiring gutters, switches, light outlets, power outlets, etc., are indicated on the drawings; however, they are not intended to give complete and exact information. Determine the exact location after thoroughly examining the general building plans and by actual measurements during construction, subject to the approval of the Architect/Engineer.
- B. Verify with Architect/Engineer, prior to installation, all locations of conduit, boxes, etc. stubbed or in the floor.

3.7 PROTECTION OF MATERIALS AND EQUIPMENT

- A. The Contractor shall be responsible for the protection of all materials and equipment under this section of the work whether incorporated into the building or not.
- B. The Contractor shall provide protection for all work where necessary and will be responsible for all damage done to property during the construction. The above protection

shall be maintained while the work is in progress. In no case shall dirt, grit, etc., be ground into the floor finish or coverings.

- C. The Contractor shall provide space for storage of materials and equipment at ground level.

3.8 CUTTING AND REPAIRING

- A. Cutting and repairing shall be the responsibility of the Contractor. Coordinate to prevent unnecessary cutting and repairing. Lay out and locate equipment, openings and chases. Install sleeves, inserts, and supports.

3.9 EXCAVATION AND BACKFILLING

- A. The Contractor shall do all necessary excavation and backfill for the installation of the systems as may be required. Curb cuts, asphalt, and concrete patching, etc., shall be part of the Contractor's responsibility. Any required trenching will be done by hand and all existing utilities avoided. Damage done to existing utilities will be repaired by the Contractor with no additional payment for the work. In addition to the above, trenches shall be backfilled with dirt, free from debris, rocks and other foreign matter. Backfill shall be replaced in the trenches in 6" layers and each 6" layer shall be wetted down adequately and properly tamped. Remove surplus dirt and leave premises clean. Perform excavation, backfilling and repaving required for work under this Division in accordance with DIVISION 2, SITE CONSTRUCTION. In general, backfill and tamp with compaction at least equal to that of the surrounding area.

3.10 WARRANTY

- A. Deliver originals of all guarantees and warranties on this portion of the work to Owner. Warrant all equipment, materials, and workmanship for one year in accordance with the terms of this Contract.

3.11 PRODUCT HANDLING

- A. Use all means necessary to protect electrical materials and equipment before, during and after installation and to protect the installed work of other trades. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no extra cost to him.

END OF SECTION 26 05 00

SECTION 26 05 13 - MEDIUM VOLTAGE CONDUCTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install all conductors as required for the complete installation and operation of all electrically serviced and/or operated equipment, devices, and systems throughout the project.

1.3 RELATED WORK IN OTHER SECTIONS

- A. Conduit, feeders, wiring devices and plates, equipment connections, panelboards, transformers, lighting equipment and lamps.

PART 2 - PRODUCTS

2.1 WIRES AND CABLES (2000 THRU 15000 VOLTS)

- A. 15 KV Cables: Where 15 KV cable is specified, it shall consist of copper single-conductor, shielded cable with 1/3 concentric neutral conforming to ICEA Specifications S-66-524, NEMA WC-7-1976, ASTM B8, and UL 1072. The voltage rating shall be 15,000 volts suitable for use on a 12470-volt grounded neutral system. The temperature rating of the cable shall be 90 degree centigrade over a 40-degree ambient with 133 percent insulation level. The cables shall have an outer jacket of neoprene or other approved material which shall be resistant to abrasion, weather, fire, oils, chemicals, heat, and aging. The insulation shall be ethylene propylene rubber (EPR). The conductors shall be as manufactured by General Electric, Anaconda, Simplex, General Cable, or Okonite.
- B. 5 KV Cables: Shall be the same as specified above except shall be rated for 5 KV for use on a 4160-volt grounded neutral system.

2.2 VERTICAL CABLE SUPPORTS

- A. Split wedge type supports which clamp each individual conductor and tightens due to weight of the cable shall be used for cables without metallic sheath. Basket weave type supports shall be used for cables with metallic sheath.

2.3 TAPE

- A. Plastic tape, 8.5 mils minimum thickness, 1,000,000 megohms minimum insulation resistance, oil resistant vinyl backing, oil resistant acrylic adhesive, incapable of supporting combustion per ASTM D-568 Test Method B.

2.4 PRIMARY TERMINATIONS AND SPLICES

- A. Shall be made utilizing splicing or terminating kits as manufactured by 3M, General Electric, Elastimold, or G and W. Kits shall be suitable for copper or aluminum conductors and shall utilize compression type connectors. The kit shall be for the type shield supplied and kits shall be utilized only in the type environment for which the kit is designed. For terminations exposed to the weather porcelain termination shall be used.

PART 3 - EXECUTION

3.1 CONDUIT SYSTEMS

- A. A complete system of conductors shall be installed in the raceway systems. Control wires shall be run in separate conduits from conductors of other systems. All conductors of all systems shall be installed in raceway or conduit.
- B. When leaving a metal raceway or conduit in a cabinet, box, switch, enclosure, control enclosure or any other like member, conductors shall be protected by means of insulated bushings or end fittings. These protectors shall be "O.Z." type or similar.
- C. Conductors may be run in multiple sizes #1/0 to 500 kcmil inclusive provided all multiple conductors are the same size, length, and type of insulation. Multiple runs are to be in separate conduits. Each conduit to include one set of phase conductors, neutral and grounding conductors. All to conform to NEC 300-20.
- D. No splices or taps shall be made in any conductors except in outlet boxes, pull boxes, junction boxes, panelboard boxes, manholes or splice boxes. All taps and splices shall be made with solderless connectors and insulated in such a manner that provides an effective insulation equal to that of the adjoining wire. Any splice or tap shall be made only on conductors which are a component part of a single circuit properly protected by approved methods.
- E. Before any wire is pulled into any conduit, the conduit shall be thoroughly swabbed in such a manner as to remove all foreign material and to permit the wire itself to be pulled in a clean, dry conduit. The Contractor shall use only approved wire pulling lubricants for pulling any wire. All conductors shall be pulled into their respective conduits by hand, except where written permission of the Engineer is secured to the contrary.

3.2 PRIMARY CABLE TERMINATIONS AND SPLICES

- A. Shall be made in complete accord with the manufacturer's recommendations and instructions furnished with the kits. Special attention is directed to the requirement that the proper kit for the cable insulation and type shielding be utilized. Terminations and splices shall not be made if weather conditions do not permit excellent cleanliness and dry conditions.

3.3 CABLE TESTS (ABOVE 600 VOLTS)

- A. After the contractor has completed the installation of the cables, they shall be tested to assure that all the material continues to possess the original characteristics as required by

the governing codes and standards listed in these specifications and as recommended by the cable manufacturer.

- B. The contractor shall furnish all instruments, equipment and personnel required for the tests which shall be conducted in the presence of the Owner or his authorized representative. These acceptance tests shall be in accordance with IPCEA-NEMA Standards after the cable is installed, but before line voltage is applied. Whether the cable will be tested before or after its termination on equipment will be determined by the Architect/Engineer.
- C. High Voltage testing as described herein shall be performed on the new cable furnished by the Contractor, as well as any existing cable that is removed and reinstalled. Tests performed on the cable shall also include the associated splices.
- D. A voltage test shall be performed on all primary cables installed or reconnected under this contract in accordance with ICEA Pub. No. S-19-81 (third edition) recommendations for ozone resisting types of insulation. In the event the cables fail to meet this test, the entire run shall be removed, and new cable installed at no additional cost. A means shall be included in the measurement for determining the wave form of the alternating current voltage. A sphere spark-gap may be used to measure the test voltage. An approved means of measuring the test voltage directly shall be used. Means shall be provided to increase and decrease the voltage gradually without steps within the time specified in the application standards. Since the cable may be connected to other apparatus during tests, care shall be taken to avoid exceeding the breakdown voltage of any connected apparatus. Any damage to electrical equipment or apparatus shall be repaired by the Contractor at no additional charge.
- E. A report of the tests shall be prepared and submitted to the Owner in quintuplicate. The report shall list the test equipment used, voltage, time applied for each cable and shall bear the signature of the Contractor and the person in charge of the tests.
- F. The Contractor shall provide the source of power as required for the test equipment.

3.4 PULL WIRES

- A. In each empty conduit, except underground conduits, install a No.14 galvanized steel pull wire or a plastic line having a tensile strength of not less than 200 pounds. In each empty underground conduit, install a No. 10 AWG bare, hard drawn copper or copper clad pull wire or a plastic line having a tensile strength of no less than 200 pounds.

3.5 IN RACEWAYS

- A. Install conductors in rigid conduit, EMT or flexible metallic conduit, unless otherwise specified or noted on the drawings.

3.6 CABLE BENDS

- A. Radius of bends not less than 10 times the outer diameter of the cable.

3.7 CONDUCTOR PULL

- A. Conductors shall not be pulled into conduits until after all plastering or concrete work is completed and all conduits in which moisture has collected have been swabbed out.

3.8 FEEDER IDENTIFICATION

- A. Tag feeder circuits in each enclosure with wrap around circuit designation labels where more than one feeder passes through or terminates in the enclosure.

3.9 CONNECTORS AND LUGS

- A. Install with manufacturer's recommended tools and with the type and quantity of deformations recommended by manufacturer.

3.10 PRIMARY CABLE INSTALLATION

- A. The installation of primary cables (over 600 volts) shall be in accordance with the manufacturer's approved recommendations. The conductors shall be free of kinks and twists and all bends and turns shall be formed with a smooth radius of minimum dimensions recommended by the cable manufacturer. The cables shall be continuous between terminal boxes. The cables shall be fanned out and marked for phase identification at each splice or termination. Cable marking shall be by means of Brady "All Temperature" markers, or other approved means.

END OF SECTION 26 05 13

SECTION 26 05 19 - LOW VOLTAGE CONDUCTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install all conductors as required for the complete installation and operation of all electrically serviced and/or operated equipment, devices and systems throughout the project.

1.3 RELATED WORK IN OTHER SECTIONS

- A. Conduit, feeders, wiring devices and plates, equipment connections, panelboards, transformers, lighting equipment and lamps.

PART 2 - PRODUCTS

2.1 WIRES AND CABLES (600 VOLTS)

- A. Type: Conform to the applicable UL and ICEA Standards for the use intended. Copper conductors with 600-volt insulation unless otherwise specified or noted on the drawings. Stranded conductors for No. 6 and larger except where elsewhere specified or noted on the drawings.
- B. Use of aluminum conductors will not be permitted.
- C. Insulation: Type THWN, 75 degrees C. insulation unless otherwise specified or noted on the drawings. 90 degrees C. minimum insulation within fixture wireways of fluorescent fixtures. Where 90 degrees C. insulation is specified, the termination points for this conductor shall be rated for 90 degrees C.
- D. Size: No. 12 minimum unless otherwise specified or noted on the drawings. In the case of "homeruns", no conductor smaller than #10 shall be used for runs over 100 feet in length on 120-volt circuits. Not less than NEC requirements for the system to be installed. If the equipment to be installed requires larger conductor and conduit sizes than indicated on the drawings, the required changes shall be made without additional charge. Remote control wires, other than Class 2 remote control and signal circuits, shall be no smaller than #14.
- E. Color Coding: Phase, neutral and equipment ground conductors color-coded. Connect all conductors of the same color to the same phase conductor. Color coding shall be A-black, B-red, C-blue, N-white, for 250 volts or less. A-yellow, B-orange, C-brown, N-off white or grey, for 251-600 volts, with green for all equipment ground conductors. Conductors No. 12 and 10 shall be solid color compounded for the entire length. Conductor sizes larger than No. 10 may be color coded at each termination and in each box or enclosure

with six inches of half-lapped 3/4-inch pressure sensitive, plastic tape of respective colors in lieu of solid color compound. The equipment grounding conductor shall be bonded to the outlet box grounding screw with taps to receptacles and equipment. Isolated ground conductors shall be green in color with a yellow trace.

2.2 CONTROL CONDUCTORS

- A. Copper, minimum size No. 14 with 19/35 stranding, color coded filled cross linked polyethylene 75 degrees C. 600-volt insulation and neoprene or equal outer jacket. Multi conductor control cables shall be provided where more than three control conductors are installed in the same conduit between common terminations. Provide two spare conductors minimum in each control cable.

2.3 DATA/COMMUNICATION AND ELECTRONIC CABLE

- A. As required or specified in the section of these specifications specifying the equipment. Splices shall be twisted and soldered or shall use an approved connector.
- B. All Cat. 3 and Cat 5 cabling shall be tested in accordance with EIA/TIA performance standards. Refer to 16740 for more detailed information.

2.4 VERTICAL CABLE SUPPORTS

- A. Split wedge type supports which clamp each individual conductor and tightens due to weight of the cable shall be used for cables without metallic sheath. Basket weave type supports shall be used for cables with metallic sheath.

2.5 CONNECTORS AND LUGS

- A. For Copper Conductors No. 6 and Smaller: 3M Scotch-Lok or T & B Sta-Kon compression or indent type connectors with integral or separate insulating caps.
- B. For Copper Conductors Larger Than No. 6: Solderless, indent, hex screw or bolt type pressure connectors, properly taped or insulated.

2.6 TAPE

- A. Plastic tape, 8.5 mils minimum thickness, 1,000,000 megohms minimum insulation resistance, oil resistant vinyl backing, oil resistant acrylic adhesive, incapable of supporting combustion per ASTM D-568 Test Method B.

PART 3 - EXECUTION

3.1 CONDUIT SYSTEMS

- A. A complete system of conductors shall be installed in the raceway systems. Control wires shall be run in separate conduits from conductors of other systems. All conductors of all systems shall be installed in raceway or conduit.

- B. Lighting fixtures shall not be used as raceways for circuits other than parallel wiring of fixtures. Wiring in fixtures shall be rated for that purpose.
- C. When leaving a metal raceway or conduit in a cabinet, box, switch, enclosure, control enclosure or any other like member, conductors shall be protected by means of insulated bushings or end fittings. These protectors shall be "O.Z." type or similar.
- D. Conductors may be run in multiple sizes #1/0 to 500 kcmil inclusive provided all multiple conductors are the same size, length, and type of insulation. Multiple runs are to be in separate conduits. Each conduit to include one set of phase conductors, neutral and grounding conductors. All to conform to NEC 300-20.
- E. No splices or taps shall be made in any conductors except in outlet boxes, pull boxes, junction boxes, panelboard boxes, manholes or splice boxes. All taps and splices shall be made with solderless connectors and insulated in such a manner that provides an effective insulation equal to that of the adjoining wire. Any splice or tap shall be made only on conductors which are a component part of a single circuit properly protected by approved methods.
- F. Before any wire is pulled into any conduit, the conduit shall be thoroughly swabbed in such a manner as to remove all foreign material and to permit the wire itself to be pulled in a clean, dry conduit. The Contractor shall use only approved wire pulling lubricants for pulling any wire. All conductors shall be pulled into their respective conduits by hand, except where written permission of the Engineer is secured to the contrary.

3.2 WIRE AND CABLE TESTS (600 Volts)

- A. Measure the insulating resistance of service entrance conductors, feeder circuit conductors and service ground. Measurements shall be taken between conductors and between conductors and ground. Resistance shall be 1,000,000 ohms or more when tested at 500 volts by megger without branch circuit loads. Tests and procedures shall meet the approval of the Architect/Engineer and shall be in accordance with the applicable IPCEA standards for the wires and cables to be installed. Furnish all instruments, equipment and personnel required for testing and conduct tests in the presence of the Architect/Engineer. Submit written reports of the tests and results when requested.

3.3 PULL WIRES

- A. In each empty conduit, except underground conduits, install a No.14 galvanized steel pull wire or a plastic line having a tensile strength of not less than 200 pounds. In each empty underground conduit, install a No. 10 AWG bare, hard drawn copper or copper clad pull wire or a plastic line having a tensile strength of no less than 200 pounds.

3.4 IN RACEWAYS

- A. Install conductors in rigid conduit, EMT or flexible metallic conduit, unless otherwise specified or noted on the drawings.

3.5 CABLE BENDS

- A. Radius of bends not less than 10 times the outer diameter of the cable.

3.6 BUNDLING

- A. In cabinets conductors No. 10 and smaller shall be neatly and securely bundled and conductors larger than No. 10 shall be neatly and securely cabled in individual circuits, utilizing marlin twine, two ply lacing or nylon straps.

3.7 CONDUCTOR PULL

- A. Conductors shall not be pulled into conduits until after all plastering or concrete work is completed and all conduits in which moisture has collected have been swabbed out.

3.8 FEEDER IDENTIFICATION

- A. Tag feeder circuits in each enclosure with wrap around circuit designation labels where more than one feeder passes through or terminates in the enclosure.

3.9 CONNECTORS AND LUGS

- A. Install with manufacturer's recommended tools and with the type and quantity of deformations recommended by manufacturer.
- B. Contractor shall review one-line and other Drawings to assure that proper lugs are provided in termination equipment such as switches, panels, switchboards, mechanical equipment, etc. Due to voltage drop conductor sizes and/or numbers may not be accommodated by the equipment affected. If manufacturer cannot provide the proper number and size of lugs within their equipment the Contractor shall provide enclosures and properly sized terminals to convert the oversized cable, number and size that is compatible to the equipment affected.

END OF SECTION 26 05 19

SECTION 26 05 26 – GROUNDING

PART 1 - GENERAL

1.1 RELATED WORK IN OTHER SECTIONS

260500 GENERAL PROVISIONS
260519 LOW VOLTAGE CONDUCTORS
260533 RACEWAYS, BOXES, AND FITTINGS
262416 PANELBOARDS
262716 CABINETS
262726 WIRING DEVICES AND PLATES
262800 MOTOR AND CIRCUIT DISCONNECTS

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials, equipment, and devices related to the grounding system are specified under other sections of these specifications.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install two separate grounding systems, a service grounding system, and an equipment grounding system. The service equipment, conduit systems, supports, cabinets, equipment, and neutral conductor shall be grounded in accordance with the minimum code requirements and as further indicated on the drawings or specified. Connect the two grounding systems together only at the main service equipment and at the secondary terminals of transformers creating separately derived distribution systems such as dry-type transformers.

3.2 SERVICE GROUNDING SYSTEM

- A. General: The service grounding system is provided for the AC service neutral ground. Current return conductors, such as neutrals of the service entrance, feeder circuits and branch circuits, shall not be used for equipment grounding. Care must be exercised to ensure that neutral bars are not bonded to the enclosures of panelboards, etc., which are not part of the main service equipment. Except for separately derived systems, the neutral conductors shall be grounded only in the main service equipment.
- B. Common Ground Point: Establish one common ground point in the main service equipment by interconnecting the insulated neutral bus (or bar), the uninsulated equipment ground bus (or bar), and service grounding electrode conductor.
- C. Neutral Disconnecting Means: Install a neutral disconnecting means in the main service equipment for disconnecting and isolating the neutral bus from the common ground. The disconnecting means may be disconnecting links in the interconnection between the insulated neutral and uninsulated equipment ground.

- D. Neutral Bars: Provide an insulated neutral bar, separate from the uninsulated equipment ground bar, in all panelboards, transformers, starters, disconnect switches, cabinets, etc. which have neutral connections.

3.3 EQUIPMENT GROUNDING SYSTEM

- A. General: Provide a complete equipment grounding system in accordance with the minimum code requirements and as further indicated on the drawings or specified. The equipment ground (green conductor) consists of metallic connections to ground of non-current carrying metal parts of the wiring system or apparatus connected to the system. The primary purpose of equipment grounding is to provide greater safety by limiting the electrical potential between non-current carrying parts of the system and to provide a low impedance path to ground for possible ground fault currents.
- B. Common Ground Point: Establish one common ground point as specified elsewhere in this section of the specifications for interconnection of the equipment grounding system and the service grounding electrode conductor.
- C. Service Equipment Enclosure: Bond the enclosure of the main service equipment to the uninsulated equipment ground bus (or bar) with a conductor or bar sized for 25% of the largest service overcurrent device.
- D. Ground Bar: Provide an uninsulated equipment ground bar, separate from any insulated neutral bar, in all switchboards, panelboards, transformers, motor control centers, starters, disconnect switches, cabinets, etc. for grounding the enclosure and for connecting other equipment ground conductors. The ground bar shall be an integrally mounted and braced bus bar in switchboards, or a separately mounted bar adequately braced or bolted to the enclosure of other types of equipment. The ground bar shall be adequately braced or bolted to the enclosure after thoroughly cleaning both surfaces to assure good contact. Provide solderless pressure connectors for all conductor terminations. Number and size of pressure connectors on equipment grounding bars as required for the termination of equipment grounding conductors. In addition to the active circuits, provide pressure connectors for all three-phase spares and spaces.
- E. Conduits: Where metallic conduits terminate without mechanical connection to a metallic housing of electrical equipment by means of lock nut and bushings, provide ground bushing connected with a bare copper conductor to the ground bar in the electrical equipment. Metallic conduits containing ground wiring only shall be bonded to the ground wire at both conduit entrance and exit. Install grounding conductor in each nonmetallic conduit or duct except those used for telephone, sound, or low-voltage signals and in all flexible conduit that does not have a built-in ground conductor. Bond the conductor at both ends to the equipment grounding system.
- F. Feeders and Branch Circuits: Provide a separate green insulated equipment grounding conductor for each single or three-phase feeder and each branch circuit with a three-phase protective device. Provide a separate green insulated equipment grounding conductor for single phase branch circuits unless otherwise indicated. Install the required grounding conductor in the common conduit or raceway with the related phase and/or neutral conductors and connect to the box or cabinet grounding terminal. Where there are parallel

feeders installed in more than one raceway each raceway shall have a green insulated equipment ground conductor.

- G. Devices: Install a minimum No. 12 green insulated equipment bonding conductor from a grounding terminal in the respective outlet or junction box to the green ground terminal of all receptacles and through flexible conduit to all light fixture housings.
- H. Motors: Install a separate green insulated equipment grounding conductor from the equipment ground bar in the motor control center of separate starter through the conduit and flexible conduit to the ground terminal in the connection box mounted on the motor. Install the grounding conductor in the common conduit or raceway with the related motor circuit conductors.

3.4 SEPARATELY DERIVED SYSTEMS

- A. Transformers creating separately derived distribution systems, such as dry-type transformers, shall utilize the equipment ground bars in the transformer enclosure for both secondary equipment ground and secondary neutral ground with separate grounding conductor extended to an approved ground electrode.

3.5 GROUNDING ELECTRODE SYSTEM

- A. A minimum of two service ground electrodes shall be utilized. One shall be the main cold water metallic water piping system and the other shall be a made electrode consisting of not less than twenty feet of bare copper conductor encased along the bottom of a concrete foundation footing which is in direct contact with the earth (NEC 250-81c). Make the connections to the cold-water pipe inside the building at the point of entrance. Other grounding electrodes (building steel, ground counterpoise, etc.) shall be bonded to the grounding electrode system where utilized. The grounding electrode for separately derived systems shall be approved for the application.

3.6 GROUNDING CONDUCTORS

- A. The grounding electrode conductors for the service grounding electrode system shall be insulated or bare copper, sized in accordance with NEC 250-94 (a), including the conductor for the supplemental electrodes. The conductors shall be continuous without joint or splice and shall be installed in conduit with the conduit bonded to the conductor at each end. Install the conductor to permit the shortest and most direct path and terminate in the main service equipment on the common ground point. Equipment grounding conductors shall be green insulated conductors equivalent to the insulation on the associated phase conductor, but not less than Type TW. The equipment grounding conductor or straps shall be sized in accordance with NEC. Where one feeder serves a series of panelboards or transformers, the equipment grounding conductor shall be continuous without splices. Grounding conductors shall not be installed through metal-sheathed holes. All connections shall be available for inspection and maintenance.

3.7 GROUND CONNECTIONS

- A. Clean surfaces thoroughly before applying ground lugs or clamps. If surface is coated the coating must be removed down to the bare metal. After the coating has been removed

apply a non-corrosive approved compound to cleaned surface and install lugs or clamps. Where galvanizing is removed from metal it shall be painted or touched up with "Galvanox", or equal.

- B. All grounding connections to bare stranded wire, ground rods, etc. shall be BURNDY HY-GROUND™ or approved equivalent or approved exothermic connection method. All connectors shall meet the requirements of IEEE STD 837 (Latest Revision), "IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding". All connectors must be listed by Underwriters Laboratories for direct burial in earth or embedment in concrete applications according to ANSI/UL-467 (latest revision), "Standard for Grounding and Bonding Equipment." Connectors must be suitable for lightning protection applications. Listing to UL-96 "Lightning Protection Components" preferred on applicable items.

3.8 TESTS

- A. Test the completed grounding system with a megger at the service ground bar and submit a written report to the Architect/Engineer for approval. The service shall not be energized if the test shows more than 5 ohms, unless approved by the Architect/Engineer.

END OF SECTION 26 05 26

SECTION 26 05 33 - RACEWAYS, BOXES, AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install complete conduit systems for the various electrical systems required for this project. Systems shall be complete with supports, mounting devices, pull boxes, etc., as required for installation of wiring systems and terminal devices.

1.3 RELATED WORK IN OTHER SECTIONS

- A. Site work, wiring devices and plates, feeders, panelboards, lighting equipment and lamps, telephone system, transformers, and services.

PART 2 - PRODUCTS

2.2 CONDUITS

- A. Steel Conduit: Rigid, threaded, thick wall, hot dipped galvanized.
- B. Electrical Metallic Tubing (EMT): Mild steel, zinc coated on the outside and either zinc coated or coated with an approved corrosion resistant coating on the inside. Maximum size 2-inch electrical trade size unless noted on the drawings or specifically approved.
- C. Intermediate Metal Conduit (IMC): Rigid, threaded, lightweight steel, zinc-coated on the outside and either zinc-coated or coated with an approved corrosion resistant coating on the inside.
- D. Flexible Conduit: Commercial "Greenfield," galvanized steel, with a separate grounding bond wire installed in the conduit in addition to other wires.
- E. Liquid Tight Flexible Conduit: Flexible galvanized steel tubing with extruded liquid tight PVC outer jacket and a continuous copper bonding conductor wound spirally between the convolutions. Where a separate grounding conductor is installed in the conduit, bonding conductor in the convolutions may be omitted.
- F. Plastic coated rigid steel conduit shall be hot dipped galvanized steel conduit with a coating of polyvinyl chloride, minimum 15 mills (0.015), on the exterior surfaces, shall have an approved corrosion resistant coat inside. To be Pittsburgh, J & L, Republic or approved equal.
- G. Rigid Non-Metallic Conduit: Schedule 40, high impact PVC with 7,000 psi tensile strength at 73.4 degrees F., 11,000 psi flexural strength, 8,600 psi compression strength, approved for 90 degrees C. conductors. Carlon, triangle, or approved equal. PVC

conduits shall include a ground wire sized as noted or as required by NEC (whichever is larger). No bends shall be made in PVC. Rigid galvanized steel conduit shall be utilized for all elbows, risers, and bends.

- H. Aluminum Conduit: Shall not be used unless specifically indicated on the drawings for specialized purposes.
- I. Conduit Size: Minimum conduit size, 1/2 inch except where specifically approved for equipment connections. Sizes not noted on drawings shall be as required by the NEC. All homeruns to panels shall be 3/4 inch minimum. Conduits for #12 THWN wire shall be sized the same as for #12 THW wire.

2.3 CONDUIT FITTINGS

- A. Connectors and Couplings: Compression type threadless fittings for rigid steel conduit or IMC not permitted. EMT couplings and connectors either steel or malleable iron only, "Concrete Tight" or "Raintight" and either the gland and ring compression type or the stainless-steel multiple point locking type. Connectors to have insulated throats. EMT fittings using set screws or indentations as a means of attachment are not permitted.
- B. All conduits shall terminate in bushings or connectors which are insulated type, designed to prevent abrasion of wires without impairing the continuity of the conduit grounding system.
- C. Rigid Steel Conduit, IMC and EMT Fittings: Iron or steel only.
- D. Liquid Tight Flexible Conduit Fittings: With threaded grounding cone, a steel, nylon or equal plastic compression ring and a gland for tightening. Either steel or malleable iron only with insulated throats and male thread and locknut or male bushing with or without "O" ring seat. Each connector shall provide a low resistance ground connection between the flexible conduit and the outlet box, conduit, or other equipment to which it is connected.
- E. Rigid Aluminum Conduit Fittings: Malleable iron, steel, or aluminum alloy. Ferrous fittings zinc coated, or cadmium plated. Aluminum alloy fittings shall conform with the characteristics defined by UL for aluminum rigid metallic conduit and shall not contain more than 0.04 percent copper.
- F. Flexible Conduit Fittings (Commercial Greenfield): Either steel or malleable iron only, with insulated throats and shall be one of the following types:
 - 1. Wedge and screw type with angular wedge fitting between the convolutions of the conduit.
 - 2. Squeeze or clamp type with bearing surface contoured to wrap around the conduit and clamped by one or more screws.
 - 3. Steel, multiple point type, for threading into internal wall of the conduit convolutions.
- G. Expansion Fittings: Each conduit that is buried in or rigidly secured to the building construction on opposite sides of a building expansion joint and each long run of exposed

conduit that may be subject to excessive stresses shall be provided with an expansion fitting. Expansion fittings shall be hot dipped galvanized malleable iron with factory installed packing and a grounding ring.

- H. Sealing Fittings: Threaded, zinc or cadmium plated, cast or malleable iron type for steel conduits and threaded cast aluminum type for aluminum conduits. Fittings used to prevent passage of water vapor shall be of the continuous drain type.
- I. Fittings for PVC Coated Rigid Steel Conduit: Ells and couplings used with PVC coated rigid steel conduit shall have a factory applied coating of polyvinyl chloride, minimum 15 mills (0.015) on exterior surfaces and shall have a PVC sleeve extruded a minimum of 2" from one end of the fitting.

2.4 WIREWAYS

- A. Square-D Company Square-Duct "lay-in" type without knockouts with lengths and fittings hinged to provide an unobstructed wireway to "lay-in" conductors. Use standard lengths. Field cuts permitted where absolutely necessary. Rust inhibiting phosphatizing coating on sheet metal parts. Blue gray baked enamel finish. Hardware plated to prevent corrosion. Provide all accessories, including tee fittings, junction boxes, cross fittings, transposition section, gusset brackets, nipples, pull boxes, reducer fittings, wall flanges, panel or cabinet flanges, elbows, ceiling, and wall support brackets and supporting hardware, etc.

2.5 BUSSED GUTTER

- A. Bussed gutter shall be amperage, voltage, and phase configuration as noted on the drawings, with a 50% ground bus. Provide lugs on bus bars as indicated on the drawings. All bus bars shall be copper. Use of aluminum bus bars will not be permitted.

2.6 OUTLET BOXES

- A. Construction: Zinc coated or cadmium plated steel boxes of a class to satisfy the condition at each outlet except where unilet or conduit bodies are required. Knockout type with knockouts removed only where necessary to accommodate the conduit entering. Square cornered, straight sided gang boxes, 4-inch octagon concrete rings and 4-inch octagon hung ceiling boxes with bars may be folded type. One piece deep drawn type for all other boxes.
- B. Size: To accommodate the required number and sizes of conduits, wires, and splices in accordance with NEC requirements, but not smaller than size shown or specified. Standard concrete type boxes not to exceed 6 inches deep except where necessary to permit entrance of conduits into side of boxes without interference with reinforcing bars. Special purpose boxes shall be sized for the device or application indicated.
- C. Fixture Studs: 3/8-inch malleable iron fixture stud in outlet boxes for ceiling lighting fixtures and interior bracket lighting fixtures, other than lamp receptacles and drop cords.
- D. Exposed: Screw joint type, with gasketed weatherproof covers in locations exposed to the weather. Shall be of the continuous drain type. Where required to be "Raintite."

- E. Tile Boxes: Rectangular in shape with square corners and straight sides for receptacles and switches mounted in furniture cabinets or in glazed tile, concrete block, marble, brick, stone, or wood walls. Install without plaster rings.
- F. Wall Mounted Switch, Receptacle and Signal Boxes: Unless otherwise noted or specified, not less than 4 inches square by 1-1/2 inches deep for single devices, 4-11/16 inches by 1-1/2 inches deep for two devices and multi gang boxes for more than two devices. Boxes for switches and receptacles on unfinished walls may be screw joint type with covers to fit the devices. Provide plaster rings, as required, to provide proper opening for device.
- G. Wall Mounted Telephone Outlet Boxes: 4-11/16 inches square by 2-1/8 inches deep, unless otherwise noted on the drawings.
- H. Light Fixture Boxes: 4-inch diameter by 1.5-inch-deep minimum for ceiling and interior bracket fixtures with concealed conduits. Plaster covers for bracket fixtures to have 3-inch diameter openings. Screw joint boxes with canopy seat for ceiling and interior bracket fixtures with exposed conduits.
- I. Grounding Terminal: Provide a grounding terminal in each box with circuits serving motor driven equipment or receptacles for grounding to a green equipment ground conductor. Grounding terminal shall be green colored washer-in-head machine screw.

2.7 PULLBOXES

- A. Minimum NEC requirements unless larger box is noted. As specified for outlet boxes with blank cover for pullboxes with internal volume not more than 150 cubic inches. As specified for cabinets for pullboxes with internal volume over 150 cubic inches, except covers to have same thickness as box with corrosion resistant screw or bolt attachment.

2.8 FLOOR BOXES

- A. Heavy duty, cast, adjustable type, suitable for the device or application indicated, unless noted. Provide carpet flanges in carpet areas.

PART 3 - EXECUTION

3.2 CONDUIT INSTALLATION

- A. Conduit Systems: Conduit shall be provided for all wiring circuits. Material shall be exposed or concealed as required by the Drawings. Rigid Steel conduit, IMC, EMT or Rigid Non-Metallic conduit unless noted. Install rigid steel conduits for underground runs, when specifically noted on the drawings, runs in concrete, feeder circuits and where required by the NEC for mechanical protection, etc. Use flexible conduit only for equipment connections and then only to the extent of minimum lengths required for connections (Typically 1'-0", maximum length 4'-0"). Install flexible conduit connections at all resilient mounted equipment. Provide liquid tight flexible conduit in exterior, wet or damp locations and for connections to all motors, dry type transformers and wet pipe mechanical systems. Aluminum conduit may be used only if specifically called for. Conduit and tubing shall be kept at least 6 inches from parallel runs of hot water or steam

pipes. PVC conduit may be used only for runs below grade or in slab. Concrete encasement is required under all paved areas. Rigid steel, galvanized elbows shall be used for all bends and risers. No PVC shall be extended above grade or slab. Ground wires, sized in accordance with NEC, shall be installed in all conduit runs, except where used for telephone conductors.

- B. Conduit Installation: Install concealed conduit and EMT in as direct lines as possible. Install exposed conduits and EMT parallel to or at right angles to the lines of the building. Right angle bends in exposed conduit and EMT runs shall be made with standard elbows, screw jointed conduit fittings or conduit bent to radii no less than those of standard elbows. Exposed conduits below the five (5) foot level shall be galvanized rigid conduit.
- C. Concealed Conduits: Install conduit systems concealed where possible unless otherwise noted. Conduit systems may be exposed in unfinished utility areas, ceiling cavities and where specifically approved by the Engineer. No conduit shall be run on roof or exposed face of building unless specifically shown on plans or approved by Engineer.
- D. Conduit in Concrete: Conduits shall not be installed in floor slabs poured on grade. Conduits under slab shall be installed a minimum 6" below slab, covered with earth. PVC coated rigid steel conduit may be embedded in above grade concrete providing the outside diameter does not exceed 1/3 thickness of concrete slab, wall or beam, is located entirely within the center third of the member and lateral spacing of conduit is not less than 3 diameters.
- E. Conduit in Ground: PVC schedule 40 non-metallic conduit may be utilized for all underground runs unless noted otherwise on the drawings. Installation and use of PVC shall comply with Article 347 of NEC. All conduit sizes, shown on the plans, shall be increased to accommodate the installation of the equipment grounding conductor. All joints shall be made with solvent cement per manufacturer's recommendations and shall be watertight. Plastic conduit runs stubbing up to above grade junction boxes or conduit runs shall be converted to PVC plastoid coated rigid steel conduit by installing a female adapter, 90-degree PVC coated rigid steel elbow and a PVC coated rigid steel nipple of length as required to stub conduit up. No plastic conduit shall be installed above grade. Plastic conduit shall be used for straight runs only. PVC coated rigid steel conduit shall be used for all bends, ells, and offsets. Where rigid galvanized steel conduit is in contact with dirt, soil, fill or earth, conduits shall be field wrapped with one layer of 3M Scotch 50 plastic tape with a 50% overlap, including all joints or couplings, or shall be coated with a bonded, 20 mil minimum thickness PVC, permanently fused at the factory, Pittsburgh Standard Co. "PlastiBond," or approved equal. All fittings, couplings, ells, etc., used with PVC coated conduit shall have same factory applied PVC coating. An equipment grounding conductor, in accordance with NEC, shall be installed in all conduits. Minimum burial depth of conduits or ducts shall be as follows:

Power: Primary (above 600v.), 42"
Secondary (below 600v.), 36"
Telephone: 24"

- F. Conduit Bends: In any conduit or EMT run, the number of quarter bends or equivalent between termination's at cabinets or boxes shall not exceed four bends. Conduit runs

between cabinets or boxes shall not exceed 200 feet for straight runs nor 100 feet for runs with maximum number of bends. Bends in telephone and data conduits shall be long sweeping bends.

- G. Conduit Openings: Protect all vertical runs of conduits or EMT terminating in the bottoms of boxes or cabinets, etc., from the entrance of foreign material prior to installation of conductors.
- H. Roof Penetrations: All roof penetrations shall be sealed as called for in the architectural plans and specifications.
- I. Pull Cords: The Contractor shall furnish and install a full length, 3/32" nylon pull cord in every "empty" conduit installed hereunder to facilitate the future installation of wires. Identify each terminus of pull wire with linen tags with complete information as to service and location of the terminus of the cord.
- J. Sealing Fittings: Install where required by the NEC, where conduits pass from warm to cold locations and where otherwise indicated.
- K. Sleeves for Conduit: Install sleeves for conduit where shown or as required. Conduit sleeves not used shall be plugged with recessed type plugs. Sleeve all conduit passing through walls. Sleeves that are used shall be caulked tight with lead yarn.
- L. Identification: Identify all exposed raceways according to the system carried. Identify exposed conduits 3/4 inch or larger in diameter by means of painted-on stencils, and conduits less than 3/4 inch in diameter with enameled-on metal tags. Provide legible lettering in contrasting colors. Abbreviate only when approved. Identification shall be placed at maximum intervals of twenty feet on straight conduit runs, close to all terminations, adjacent to all change in directions and where conduits pass through walls or floors. In general, use yellow color. Painting shall be in accordance with DIVISION 9 - FINISHES.

3.3 CONDUIT SUPPORTS

- A. Supports: Provide supports for horizontal conduits and EMT not more than 8 feet apart with not less than two supports for each 10-foot straight length and one support near each elbow or bend including runs above suspended ceilings and within 3 feet of all junction boxes, switches, fittings, etc.
- B. Straps: Install one-hole pipe straps on conduits 1.5 inch or smaller. Install individual pipe hangers for conduits larger than 1.5 inch. Spring steel fasteners with hanger rods may be used in dry locations in lieu of pipe straps.
- C. Trapezes: Install multiple (trapeze) pipe hangers where two or more horizontal conduits or EMT run parallel and at the same elevation. Secure each conduit or EMT to the horizontal hanger member by a U-bolt, one-hole strap or other specially designed and approved fastener.

- D. Hanger Rods: Install 1/4-inch diameter or larger galvanized steel rods for trapezes, spring steel fasteners, clips and clamps. Wire or perforated strapping shall not be used for the support of any conduit or EMT.
- E. Fastening: Fasten pipe straps and hanger rods to concrete by means of inserts or expansion bolts to brickwork by means of expansion bolts and to hollow masonry by means of toggle bolts. Wooden plugs and shield shall not be used. Power driven fasteners may be used to attach pipe straps and hanger rods to concrete only where approved by the Engineer.
- F. All conduits not embedded in concrete shall be firmly secured by means of pipe clamps, hangers, etc., equal to Caddy fasteners of ERICO Products, Inc. Wire wrapped around conduits and supporting members will not be accepted.
- G. On Roof: All conduits laid on roof shall be supported on 4" redwood blocks, mopped into roof and spaced at 5'-0" on center.
- H. Lay-in Ceiling: Conduits routed above acoustical "lay-in" ceilings shall be anchored to the building structure and not laid on the ceiling. Wire shall not be used to anchor boxes to structure. If ceiling support system is adequate, one 3/4" maximum conduit may be supported by a Caddy Clip to hanger wire. Multiple runs of conduit shall be racked on trapeze hanger. All support materials shall be rustproof. Perforated tape or soft iron wire shall not be used.

3.4 CONDUIT STUB-UPS

- A. Conduits run under floor shall be stubbed up to a coupling set flush with floor. This excludes conduits stubbed up in walls and feeder conduits. Install flush plug until after floor is finished, then complete connections to boxes or equipment.

3.5 OUTLET BOXES

- A. Outlet Boxes: Outlet boxes, covers and fittings, according to the particular use for which they are required, shall be provided in the locations marked on the drawings by symbols, and/or for use to facilitate the installation of the electrical systems. When necessary, outlets shall be relocated so that when fixtures of other fittings are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment required by the drawings and/or specifications.
- B. Installation: Unless otherwise specified or shown on the drawings, outlet boxes shall be flush mounted and the front edges of the boxes or plaster covers shall be flush with the finished wall or ceiling line or if installed in walls and ceilings of incombustible construction, not more than 1/4 inch back of same. Mount boxes with the long axes of devices vertical, unless otherwise specified. Boxes in plastered walls and ceilings shall be provided with plastic covers. A multiple of box extensions and/or covers will not be permitted. Install in a rigid and satisfactory manner with suitable metal bar hangers, box cleats, adjustable box hangers, etc. Use wood screws on wood, expansion shields on masonry and machine screws on steel work.

- C. Mounting Heights: The mounting height of a wall mounted outlet box shall be construed to mean the height from the finished floor to the horizontal center line of the cover plate. On exposed tile, block or brick construction, mount outlet boxes at the nearest bed joint to the mounting height indicated. Wall Mounted Switch, Receptacle and Signal Outlets: On columns, pilasters, etc., mount so the centers of the columns are clear for future installation of partitions. Install outlet boxes near doors or windows close to trim. Install outlet boxes near the doors on the lock sides (see architectural drawings for correct door swings).
- D. Identification: Identify all exposed junction boxes according to the system carried by means of painted-on stencils or labels with legible letters and contrasting colors and without abbreviations. In general, use yellow color. Painting shall be in accordance with DIVISION 9 - FINISHES.

3.6 PULLBOXES

- A. Provide additional pullboxes wherever necessary to meet requirements for maximum length of conduit runs and maximum numbers of bends.

3.7 FLOOR BOXES

- A. Install level with top covers adjusted flush with finished floor or floor tile.

3.8 FIXTURE CONNECTIONS

- A. Recessed or surface light fixtures in lay-in or accessible ceilings shall be connected with minimum 1/2-inch flexible metallic conduit, 4 to 6 feet long with grounding provisions.

3.9 CLOSING OF OPENINGS

- A. Wherever slots, sleeves or other openings are provided in floors or walls for the passage of conduits or other forms of raceway, such openings, if unused, or the spaces left in such openings, shall be filled, or closed in an approved manner.

3.10 IDENTIFICATION

- A. Refer to Section 260500 - GENERAL ELECTRICAL PROVISIONS for identification requirements for raceways and boxes.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Underground warning tape.

1.2 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; Latest Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace; latest edition.

1.3 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 - PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Switchboards:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Motor Control Centers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - c. Panelboards:

- 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 4) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
- d. Transformers:
- 1) Identify power source and circuit number. Include location when not within sight of equipment.
- e. Enclosed switches, circuit breakers, and motor controllers:
- 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
- f. Busway:
- 1) Identify power source and circuit number. Include location when not within sight of equipment.
 - 2) Provide identification at maximum intervals of 40 feet (12 m).
 - 3) Use identification nameplate to identify load(s) served for each plug-in unit. Include location when not within sight of equipment.
- g. Enclosed Contactors:
- 1) Identify voltage and phase.
 - 2) Identify load(s) and associated circuits controlled. Include location.
- h. Transfer Switches:
- 1) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
 - 2) Identify load(s) served. Include location when not within sight of equipment.
2. Service Equipment:
- a. Use identification nameplate to identify each service disconnecting means.
 - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
 - c. Use identification nameplate at each piece of service equipment to identify the available fault current and the date calculations were performed.
3. Emergency System Equipment:
- a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
 - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
4. Use identification label to identify overcurrent protective devices for branch

- circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
5. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches.
 - b. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash hazard study performed in accordance with Section 26 0573:
 - 1) Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
 - 2) Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
 - 3) Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
- C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less as follows:
 - a. The phasing of all conductors (#8 and larger) shall be identified by color coding tape. Conductors sizes #10 and smaller shall have colored insulation. The grounded (neutral) conductor sizes #6 and smaller shall be white or light gray or have 3 continuous white stripes on other than green insulation. Grounded (neutral) conductors larger than size #6 shall be color coded white with coding tape. Grounding conductors' sizes #6 and smaller shall have green insulation or be bare the entire length. Grounding conductors larger than size #6 shall be color coded green with coding tape.
 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
- D. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
 2. Use voltage markers or color-coded boxes to identify systems other than normal power system.
 - a. Color-Coded Boxes: Field-painted in accordance with Section 09 9000 per the same color code used for raceways.
 - 1) Fire Alarm System: Red.
- E. Buried Electrical Lines: Underground warning tapes.
- F. Communication Cabinets: Nameplates.
- G. Control Device Station: Labels.
- H. Electrical Distribution and Control Equipment Enclosures: Nameplates.

- I. Junction Box Load Connections: Wire markers.

2.2 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Seton Identification Products: www.seton.com/aec.
- C. HellermannTyton: www.hellermanntyton.com.

2.3 IDENTIFICATION NAMEPLATES AND LABELS

- A. Nameplates: Engraved three-layer laminated plastic, black letters on white background, unless indicated otherwise for nameplates for Essential Power System equipment.
 - 1. Engraving stock shall be melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 2. Nameplates and labels shall have punched or drilled holes for mechanical fasteners.
 - 3. Nameplates and labels shall be fastened using self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts with flat and lock washers.
- B. Locations:
 - 1. Each electrical distribution (switchboards, distribution panels and panelboards) and control equipment enclosure.
 - 2. Communication cabinets.
 - 3. All special systems cabinets.
- C. Letter Size:
 - 1. Use 1/8-inch letters for identifying individual equipment and loads.
 - 2. Use 1/4-inch letters for identifying grouped equipment and loads.
- D. Labels: Embossed adhesive tape, with 3/16-inch white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations, and identified specialized power devices.

2.4 WIRE AND CABLE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com.
 - 2. Seton Identification Products: www.seton.com.
 - 3. HellermannTyton: www.hellermanntyton.com.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.
- G. Description: Vinyl cloth type self-adhesive wire markers.
- H. Locations: Each conductor at panelboard gutters, pull boxes, and junction boxes each load connection.

2.5 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com.
 - 2. Seton Identification Products: www.seton.com.
 - 3. HellermannTyton: www.hellermanntyton.com.
- B. 4" Polyethylene tape, Foil-backed Detectable Type Colored Red Tape: 4" inches wide, with minimum thickness of 4 mil, with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION

- A. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker.
- B. Install line marker for underground wiring, both direct buried cables and cables in raceway.
- C. Paint fire alarm junction boxes red.
- D. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout.
- E. Electrical Gear and Equipment Identification Labels: Engraved plastic laminate shall be

installed on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch-high lettering on 1-1/2-inch-high label. Where two lines of text are required, use labels that are 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of electrical gear and equipment using mechanical fasteners:

1. Interior and exterior of switchgear, switchboards, distribution panelboards, panelboards, motor control centers, electrical cabinets, enclosures and other equipment.
 - a. Main Overcurrent Protection: Identify main device and service disconnects.
 - b. Switchboards and Switchgear: Identify equipment, label main and distribution overcurrent protection showing load served and location (identify room numbers, where possible).
 - c. Distribution Panelboards: Identify Distribution Panelboard designation and circuit serving distribution panelboard. Label main and distribution overcurrent protection showing load served and location (identify room numbers, where possible).
 - d. Branch Panelboards: Identify distribution panel and circuit serving panelboard.
 - e. Motor Control Centers: Identify equipment designation, voltage, phases and full-load current capacity. Label main and distribution overcurrent protection.
 - f. Disconnect Switches: Identify equipment designation, voltage and horsepower rating or full-load current capacity.
 - g. Enclosed Circuit Breakers: Identify equipment designation, voltage and full-load current capacity.
 - h. Motor Starters: Identify equipment designation, voltage and horsepower rating or full-load current capacity.
 - i. Power Transfer Equipment (Manual and Automatic): Identify equipment designation, power sources, voltage and full-load current capacity.
2. Identification Labels for Other Electrical Equipment: Engraved plastic laminate shall be installed on each unit of equipment. Unless otherwise indicated, provide a single line of text with 1/2-inch-high lettering on 1-1/2-inch-high label. Where two lines of text are required, use labels that are 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of electrical gear and equipment using mechanical fasteners:
 - a. Transformers.
 - b. Frequency converters.
 - c. Power inverters.
 - d. Lighting contactors.
 - e. Push-button stations and other control stations or devices.
 - f. Telephone switching equipment.
 - g. Battery racks.
 - h. Power-generating units.
 - i. Nurse call system master station.
 - j. Paging system master station.
 - k. TV/audio-monitoring master station.

- l. Fire alarm system master station or control panel.
 - m. Fire alarm system extender or battery panel.
 - n. Security-monitoring master station or control panel.
 - o. Master clock or program equipment.
- F. Provide framed, typed circuit schedules for all panelboards with explicit description and identification of items controlled by each individual circuit breaker.
1. Existing Panelboards: Identify existing circuits as well as new circuits with new, typed circuit schedules.
 - a. 208 Volt System: Black
 - b. Other Special Systems: Yellow.
- G. Circuit Identification Labels: Provide external labels for all installed device face covers and junction boxes prior to installation of conductors. Circuit identification shall be as shown below.
1. Labeling Legend for Junction Boxes: Provide permanent, waterproof label listing panel and circuit number.
 2. Labeling Legend for Device Face Covers in Patient Care Areas, as defined by NEC Article 517: Provide permanent, adhesive label listing the panel and circuit number.
 3. Circuit Identification Labels on Cover or Face Plates: Install labels externally for all installed wiring device plates indicating panel and circuit number.
 - a. Clear preprinted adhesive labels.
- H. Color-Coding for Secondary Phase Conductors: Color code switch legs, travelers, and other wiring for branch circuits other than those listed below. Permanently post color code at each branch panelboard. Use the following colors for service, feeder, and branch-circuit phase conductors: (Ref: NEC # 210.4, 200.6, 250.119.)
1. 208/120-Volt, 3-Phase System Conductors:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral (Common): White.
 - e. Ground (Earth): Green.
 2. 480/277-Volt, 3-Phase System Conductors:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral (Common): Gray.
 - e. Ground (Earth): Green.
- I. Circuits Operating at More Than 600 Volts: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches high, stenciled with paint at 10-foot (3-m) intervals over a continuous, painted orange background. Identify the following:

1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to conduits concealed within wall.
 3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.
 4. Entire surface of exposed conduits.
- J. Electrical identification in healthcare facilities shall comply with the following requirements:
1. All electrical outlets in patient care areas, as defined in NEC 517, shall have a permanent label affixed to the faceplate cover indicating the panel name and circuit number feeding that outlet.
 2. All electrical switches in patient care areas, as defined in NEC 517, shall have a permanent label affixed to the faceplate cover indicating the panel name and circuit number feeding that outlet.
 3. Labeling on faceplate covers in Critical Care Units (CCU), Neonatal Intensive Care Units (NICU's), Intensive Care Units (ICU's), Operating Rooms (OR's) and other similar areas in healthcare facilities shall be accomplished by permanently engraving the faceplate cover with the panel name and circuit number feeding that outlet or switch.

END OF SECTION 26 05 53

SECTION 26 12 00 - MEDIUM VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install transformers complete with all necessary appurtenances to perform the voltage transformation as required.

1.3 SUBMITTALS

- A. Submit complete shop drawings with outline dimensions, wiring diagrams, catalog cuts and descriptive literature, including no load loss, total loss, regulation at 100% and 80% power factor, and net weight. If requested by the Engineer, submit production line impulse test reports.

1.4 RELATED WORK IN OTHER SECTIONS

- A. Site work, services.

PART 2 - PRODUCTS

2.1 PADMOUNTED TRANSFORMERS

- A. General: Sizes and characteristics as shown on drawings, loop or radial feed as shown on drawings. Unless otherwise specified on the drawings, transformers to be three-phase 60 hertz, 65 degree C temperature rise, liquid filled, self-cooled, pad mounted, compartmentalized distribution transformers, rated 1,500 KVA and below for use with separable insulated high-voltage connectors rated 8.3/14.4 KV (or 2.5/5 KV where indicated on the drawings). All characteristics, definitions, terminology, and voltage designations, except as otherwise specified herein, shall be in accordance with applicable provisions of the latest edition of ANSI C57.12.26, or its C57.12.00-1980, C57.12.90-1980, and C57.12.80-1980, (or the latest editions). Transformers shall be of triplex or five-legged core design and connected wye-wye with primary and secondary neutrals internally connected and brought out to a neutral bushing in the secondary compartment. All windings shall be copper.
- B. ELECTRICAL CHARACTERISTICS: KVA ratings will be as indicated on the drawings. Voltage ratings and tap ratings shall be 2-2 1/2% above and below. Taps shall be suitable for de-energized operation only. The tap changer switch shall be ganged and shall be externally operable. The operating handle shall be located either in the high compartment above the low voltage bushings or in the secondary compartment above the low voltage bushings. The tap changer shall be set on the 100% tap at the factory and shall be secured to prevent inadvertent change from this position. Minimum impedance's will be as follows:

KVA	SECONDARY VOLTAGE	IMPEDANCE
UP TO 500	208Y/120	4.5%
UP TO 500	480Y/277	4.5%
750 & ABOVE	208Y/120	5.75%
750 & ABOVE	480Y/120	5.75%

- C. Construction: The padmounted transformer shall consist of the transformer tank, high voltage cable terminating compartment and the low voltage cable terminating compartment. The transformer tank and compartments shall be assembled as a raintight and weatherproof tamper resistant integral unit suitable for mounting on a flat surface. There shall be no exposed screws, bolts, or other fastening or hinging devices (other than the pentahead specified) which are externally removable. There shall be no opening through which foreign objects such as sticks, or wires might be inserted to contact energized parts. Suitable means for padlocking the compartment door(s) shall be provided. Normal entry shall be possible only with the use of proper access tools. The high- and low-voltage compartments shall be located side by side on one side of the transformer tank. When facing the compartment, the low voltage compartment shall be on the right. Construction of the unit shall be such that it can be lifted, skidded, and slid onto place on the mounting pad without disturbing the entrance cables. The transformer tank base shall be raised above the pad to protect the bottom finish during installation and to minimize corrosion due to moisture accumulation. The base shall be cross braced to permit rolling in two directions. All external surfaces of ferrous material used in the construction of the assembly shall have undercoating over the regular finish, applied to the bottoms of the components, and extending up the side to a point 1 inch above the bottom of their bases. All exterior surfaces shall be painted using a system of coordinated and thoroughly tested materials and application techniques that will assure long life in outdoor exposure. The finish shall be weather-resistant, green color Munsell No. 7.0 GY 3.29/1.5. Total paint thickness measured anywhere on inside or outside of transformer and cabinet shall not be less than 3.5 mils. All external surfaces shall be constructed of steel, 13 USS gauge or thicker. The transformer and compartment hoods shall be crowned to ensure water runoff.
- D. High- and Low-Voltage Compartments: Terminal compartments shall be full height, air filled compartments with separate hinged doors. The compartments shall be completely isolated from each other by a steel barrier without opening or discontinuity of any kind. The edges of the access doors shall be formed to provide a close-fitting mating surface, with internal insertion-prevention lip that will be shaped to resist entry or prying by screwdrivers, wrecking bars, tire irons, single-socket lug wrenches or other readily accessible tools. Hinges and hinge pins shall be passivated AISI Type 304 stainless steel or equivalent corrosion-resistant metal. There shall be a threaded fastening device for the high voltage door, accessible only through the low voltage compartment. Screen door latches with wing nuts, gravity hooks, etc. are unacceptable. The compartment doors shall have a minimum of three-point latching and the handle shall have provisions for pad locking. The padlocking device shall be so designed and located as to resist prying or breaking off by screwdrivers, wrecking bars, tire irons, single-socket lug wrenches or other readily accessible tools and to inhibit removal of the padlock with a bolt cutting device or hacksaw. In addition to the regular locking provisions above, the access doors shall be secured by a captive, recessed pentahead bolt. Bolts and associated hardware must be rust and corrosion resistant and the design shall minimize the possibility of

misalignment and cross-threading. The design must be such that wire entry through the bolt hole into the compartment(s) is prohibited when the bolt is removed. The non-rotating cup shall be permanently attached. The captive pentahead bolt shall be coordinated with the latch and padlock to prevent unlatching and insertion of the padlock into the hasp when and until the bolt is completely threaded, respectively. The captive pentahead shall also function as an interlock device to pin the latch closed. Both compartment doors shall be equipped with stops for holding each door in a 90-degree open position. The stops shall be captive to prevent loss of the device. Doors on the high- and low-voltage compartments shall be of sufficient size to provide adequate working space when open. The bottom edge of the transformer shall provide for flush mounting on a flat rigid surface to prevent wire entry into the compartment.

- E. Bushings and Terminals: Electrical characteristics of completely assembled low-voltage terminations shall comply with Table 4 of ANSI C57.12.26-1975, (or the latest edition) unless otherwise stated herein. All low voltage terminals shall be insulated from the tank with 1.2 KC OF % KV class bushings as applicable. Terminals of 480Y/277 and 208Y/120-volt windings shall be arranged to the specified dimensions shown in Figures 7 and 8 (a) of ANSI C57.12.26-1975, (or the latest edition). In-line arrangements are unacceptable. The high voltage neutral shall be connected to the low voltage neutral internally with provision for opening this connection for testing. The low voltage neutral shall be a fully insulated bushing. A ground pad shall be provided. A removable copper ground strap shall be provided and connected between the neutral bushing and ground pad. The ground strap shall be capable of carrying a line to ground fault of the magnitude and duration defined in ANSI C57.12.00b-1980, (or the latest edition). A hand hole shall be provided to access the removable connection specified in 7.3. Low voltage terminals shall be spades with NEMA hole spacing to provide the number of holes given in the following table.

Secondary Terminal Construction

Secondary Voltage	Transformer KVA Size/Hole Count						
	75	150	300	500	750	1000	1500
208Y/120	4	6	6	8	8	--	--
480Y/277	4	6	6	6	6	8	8
4160GrdY/2400	--	--	--	2	2	2	2

- F. High voltage terminals shall be bolted type bushing wells in accordance with ANSI/IEEE 386-1977, (or the latest edition) and ANSI C57.12.26-1975, (or the latest edition). Bushing wells shall be in accordance with Figure 1 of ANSI/IEEE 386-1977, (or the latest edition) and shall be arranged in accordance with the specific dimensions of Figures 5 and 7 of ANSI C57.12.26-1975, (or the latest edition). Transformers design shall allow field replacement of the high voltage bushing wells and low-voltage bushings by means of common hand tools and oil-handling equipment, without totally un tanking the transformer.
- G. Accessories: The following accessories are required on all transformers:
1. Pressure relief device. The following are approved:
 - a) Qualitrol 202 Series
 - b) Tomco/Beta 1712K-3

2. Upper filter valve or plug.
 3. Combination drain, lower filter valve, and sampling device.
 4. The following accessories are required on all transformers rated 750 KVA and above:
 - a) Liquid level gauge.
 - b) Top oil thermometer.
- H. A suitable marking inside the tank shall indicate the correct liquid level at 25 degree C temperature.
- I. Jacking, Rolling, Lifting, and Mounting Facilities: Suitable jack bosses or equivalent jacking facilities shall be provided on the tank. vertical clearance for a jack shall be 1-1/2 inches minimum, 3-1/2 inches maximum. Transformer base shall be arranged for rolling in two directions: Parallel to and at right angles to the center line of the high-voltage bushings. These lugs shall be of adequate strength and size and arranged on the tank to provide a suitable lift for the completely assembled unit. A 3/4 inch minimum and a 1-1/2-inch maximum internal flange shall be provided at the base of the high-voltage and low-voltage compartments, to provide means of anchoring the unit to the pad.
- J. Terminal Markings: External terminals shall be marked H1, H2, H3, HoXo, X1, X2, X3, by stenciled yellow lettering on the tank. A winding diagram with high and low-voltage connections shall be shown on the instruction nameplate.
- K. Instruction Nameplate: Instruction nameplate shall be located on the inside of the low-voltage compartment door. Instruction nameplate shall contain the information specified in paragraph 5.12 ANSI C57.12.00-1980, (or the latest edition) nameplate B, and shall be easily readable. Nameplate shall indicate that the transformer oil contained less than 1 ppm PCB at time of manufacture.
- L. Oil Preservation: Transformers shall be of sealed tank construction, so designed that the interior is sealed from the atmosphere and the gas plus oil volume remains constant. The transformer shall remain effectively sealed for all temperatures to plus 105 degree C top oil.
- M. Tanks: The tank shall be of sufficient strength to withstand a pressure of 7 psi gage, without permanent distortion.
- N. Overcurrent Protection: Internal fuse protection shall be accomplished through the use of drawout, load break, current limiting fuses in a dry well. Fuses to be sized for transformer protection. Fuses shall be in series with a gang-operated, load break oil switch in the configuration as shown on drawings.
- O. Switching: Provide an oil-immersed, gang-operated, two-position, loadbreak, manually operated switch.

2.2 GROUNDING

- A. The materials, equipment, and devices related to the grounding system are specified under other sections of these specifications.

PART 3 - EXECUTION

3.1 SEPARATELY DERIVED SYSTEMS

- A. Transformers creating separately derived distribution systems such as dry type transformers shall utilize the equipment ground bars in the transformer enclosure for both secondary equipment ground and secondary neutral ground. The size of grounding conductor from the transformer to the main equipment ground shall be determined by considering the transformer secondary as a service.

3.2 TESTING

- A. The Contractor shall test the complete grounding system with a megger at the service ground bar and shall submit a written report to the Engineer for approval. The service shall not be energized if the test shows more than 5 ohms, unless approved by the Architect.

3.3 GROUNDING CONNECTIONS

- A. Clean surfaces thoroughly before applying ground lugs or clamps. If the surface is coated, the paint, enamel or lacquer must be removed. Where galvanizing is removed from metal, it shall be painted or touched up with "Galvanox."

3.4 IDENTIFICATION

- A. Provide an engraved micarta label on front of the tank indicating the transformer power source and the panel fed by the transformer.

END OF SECTION 26 12 00

SECTION 26 22 00 - LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install transformers complete with all necessary appurtenances to perform the voltage transformation as required.

1.3 SUBMITTALS

- A. Submit complete shop drawings with outline dimensions, wiring diagrams, catalog cuts and descriptive literature, including no load loss, total loss, regulation at 100% and 80% power factor, and net weight. If requested by the Engineer, submit production line impulse test reports.

1.4 RELATED WORK IN OTHER SECTIONS

- A. Site work, services.

PART 2 - PRODUCTS

2.1 DRY TYPE TRANSFORMERS

- A. General: Sizes and characteristics as shown on drawings. Unless otherwise specified, the design, manufacture and testing of dry type transformers and the methods of conducting tests and preparing reports shall be in accordance with NEMA Standard Publication for Specialty Transformers, No. ST1-4 (USASI-089). Provide separate primary and secondary windings for each phase (except where buck-boost auto transformers are indicated on the drawings) with industry standard voltage taps. All windings shall be copper. Provide with a suitable terminal compartment. The terminal compartment temperature shall not exceed 75 degrees C. when the transformer is operating continuously at rated load with ambient temperature of 40 degrees C.
- B. Insulation: Class H insulation shall be rated for continuous operation of KVA with a temperature rise of not over 115 degrees C. above a 40 degrees C. ambient and with a maximum hot spot temperature of 220 degrees C.
- C. Enclosures: Ventilated for air cooling. Single phase transformers larger than 25 KVA and three phase transformers larger than 15 KVA shall be in a heavy gauge, sheet steel enclosures. Ventilation openings shall be of the mechanical maze type designed to prevent direct access to live parts in accordance with U.L., NEMA and National Electrical Code requirements for ventilated enclosures. Transformers smaller than the above shall be fully enclosed, in steel enclosures, with or without compound fill, or shall have exposed cores, impregnated windings and steel enclosures enclosing all live parts.

- D. Sound Rating: Noise levels, determined in accordance with NEMA standards for Specialty Transformers, shall not exceed the following: 40db less than 50 KVA, 45db 51-150 KVA, 50db 151-300 KVA.
- E. Manufacturers: General Electric, Hevi-Duty, Westinghouse or Sorgel. If requested, the transformer manufacturer shall furnish written certification that all dry type transformers furnished are constructed and tested in accordance with the standards referenced herein.
- F. Mounting: Unless otherwise indicated on the drawings, dry type transformers having ratings not exceeding 45 KVA shall be suitable for wall mounting. Shop drawings of wall brackets and platforms for transformers having ratings exceeding 30 KVA shall be submitted for approval. All floor mounted transformers shall be provided with a 4" high 3000 psi concrete housekeeping pad.
- G. Noise Suppression: Mount on approved vibration and noise vibration and noise isolating and damping supports. Conduit connections to transformers shall be made with sealtite flexible metal conduit, not less than 18 inches nor more than 36 inches in length.

2.2 GROUNDING

- A. The materials, equipment, and devices related to the grounding system are specified under other sections of these specifications.

PART 3 - EXECUTION

3.1 SEPARATELY DERIVED SYSTEMS

- A. Transformers creating separately derived distribution systems such as dry type transformers shall utilize the equipment ground bars in the transformer enclosure for both secondary equipment ground and secondary neutral ground. The size of grounding conductor from the transformer to the main equipment ground shall be determined by considering the transformer secondary as a service.

3.2 TESTING

- A. The Contractor shall test the complete grounding system with a megger at the service ground bar and shall submit a written report to the Engineer for approval. The service shall not be energized if the test shows more than 5 ohms, unless approved by the Architect.

3.3 GROUNDING CONNECTIONS

- A. Clean surfaces thoroughly before applying ground lugs or clamps. If the surface is coated, the paint, enamel or lacquer must be removed. Where galvanizing is removed from metal, it shall be painted or touched up with "Galvanox."

3.4 IDENTIFICATION

- A. Provide an engraved mica label on front of the tank indicating the transformer power source and the panel fed by the transformer.

END OF SECTION 26 22 00

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section

1.2 DESCRIPTION OF WORK

- A. Furnish and install complete, all panelboards.

1.3 RELATED WORK IN OTHER SECTIONS

- A. Cabinets; Motor & Circuit Disconnects; Fuses; Service and Distribution; Grounding; Conductors, Raceways, Boxes and Fittings.

1.4 SUBMITTALS

- A. Submit complete shop drawings with outline dimensions, descriptive literature and complete descriptions of the frame size, trip setting, class and interrupting rating of all overcurrent devices. Identify available spaces. Complete description of physical layout of panelboards showing conformance with drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Dead front, safety type, with voltage and amperage ratings as scheduled. Panelboards shall be of the type required for the short circuit and duty ratings indicated on the drawings or specified. All panelboards shall have a neutral bus and an insulated ground bus. Panelboards shall be as manufactured by General Electric, Cutler-Hammer or Square D and shall be as scheduled.

2.2 CABINETS

- A. Each panelboard shall be enclosed in a sheet metal cabinet with front doors, catches, locks, etc., as specified in Section 262716 - CABINETS.
- B. Door-in-Door: Both surface and flush panels shall be door-in-door. The door over the interior of the panel shall be provided with hinges and combined lock and latch. The outside door over the panel gutters shall be provided with hinge(s) on one side and combined lock and latch. Machine screws into threaded holes in the panelboard cabinet, in lieu of combined lock and latch, to secure the outside door are not acceptable.

2.3 FUSIBLE PANELBOARD

- A. Fusible panelboards shall be factory assembled, each fused switch shall have an etched micarta nameplate secured by two cadmium plated screws. The panelboard shall have a neutral bus and a ground bus connected with a removable link.
- | | |
|------------------|-----------------------|
| General Electric | "QMR" up to 1200 amps |
| Square D | "QMB" up to 1200 amps |
- B. Quick-make, quick-break fusible switch units to be of type with external operating handle suitable for padlocking in OFF position. Provide interlock to prevent opening cover when switch is in ON position unless interlock release is operated. Provide frame and fuse clip ratings as indicated in the panelboard schedules. Switch and fuse holder shall be rated for 200,000-amp interrupting capacity. Fuse holders shall be provided with Class R rejection feature.
- C. Fuses shall be provided for all switches. Fuses for switches serving motors shall be Bussman Fusetrons, sized for heavy service motor running protection. Fuses for other services shall be as designated on the drawings. Proper fuse amp ratings shall be indicated on inside of switch cover, through the use of "Tapewriter" and should read "Use Fusetrons Only" (indicate amperage size as shown on plans).
- D. Space Only: Where "space only" is noted on the drawings, provide necessary connectors, mounting brackets, etc., for the future insertion of an overcurrent device. Spaces shall be sized 200 amps unless noted otherwise.

2.4 CIRCUIT BREAKER PANELBOARDS

- A. Panelboard interiors shall be constructed on pre-drilled and tapped channel rails. Main busses shall be pre-drilled and tapped to accommodate any combination of circuit breaker units without further modification. All panelboards shall be complete with doors. Units shall be complete with combination latch and cylinder locks. All locks shall be keyed alike. All bussing shall be of the "sequence type". All connections shall be bolted.
- B. Circuit breakers shall be molded case type (minimum 10,000-amp interrupting capacity, larger as required). All multi-pole breakers shall have a common trip and all breakers shall be interchangeable in any combination of poles with the same frame size. All branch circuit straps shall have the capacity of the maximum breaker size in the frame space (i.e. 100-amp strap for 100-amp frame). Minimum 100-amp straps will be accepted.
- C. All main and branch breakers shall be of the size and have the interrupting rating scheduled on the Drawings. All incoming and outgoing terminals shall have solderless lugs. Provide, where required, lug landing to accommodate number and size conductors shown on the Power Riser. Panelboards shall be factory assembled.
- D. Single pole circuit breakers shall be suitable for switching duty and marked "SWD".
- E. Bolted Type: Circuit breaker current carrying connections to the bus shall be of the bolted type, factory assembled. Stab in type not permitted. Provide bus bars for three phase

panelboards of the sequence phased type connection and arranged for 3 phase, 4 wire mains, unless otherwise indicated on the drawings.

- F. Space Only: Where "space only" is noted on the drawings, provide necessary connectors, mounting brackets, etc., for the future insertion of an overcurrent device. Provide blank cover for each space.
- G. Directories: Provide typewritten circuit descriptions referencing permanent room numbering assigned in lieu of the room numbering shown on the drawings.
- H. Spare Conduit: Provide three spare 1" conduits for each panel. Extend empty conduit with pullwire into accessible ceiling space and stub-out for future use.

2.5 NAMEPLATE

- A. Labels for identifying the breakers shall be engraved laminated plastic strips attached by screws (see "Nameplates" Specifications in Section 260500) or labels supplied by Panel Manufacturer.
- B. Nameplates on Panelboards shall give voltage characteristics phase and number of wires. Example: Panel A, 120/208V, 3-phase, 4W.
- C. Individual circuit breakers or switches, panelboards, disconnect means and motor starters shall have nameplate showing the load served.
- D. Blank name plates shall be mounted on each "spare" unit or on "space" in distribution panels.

2.6 SKIRTS

- A. Where noted on the drawing's panelboards shall be skirted with complete metal enclosures and barriers separating the panel interior.

2.7 BUS BARS

- A. All bus bars shall be copper. Use of aluminum bus bars will not be permitted.

2.8 CONNECTORS AND LUGS

- A. Contractor shall review one-line and other Drawings to assure that proper lugs are provided in termination equipment such as switches, panels, switchboards, mechanical equipment, etc. Due to voltage drop conductor sizes and/or numbers may not be accommodated by the equipment affected. If manufacturer cannot provide the proper number and size of lugs within their equipment the Contractor shall provide enclosures and properly sized terminals to convert the oversized cable, number and size that is compatible to the equipment affected.

PART 3 - EXECUTION

3.1 PANELBOARDS

- A. Panelboards shall be located where indicated on the drawings. Panelboards shall have neatly typed circuit directories behind clear plastic. Identify circuits by area designations and use. "Spare" and "Space" shall be indicated with erasable pencil, not typed.
- B. Circuiting of all branch circuits shall be as designated on the drawings. Breaker and switch arrangement in panels shall be exactly as specified and all circuits will terminate in the positions indicated.

3.2 PHASE ROTATION

- A. Phase A, left bus; phase B, center bus; phase C, right bus (front viewing).

END OF SECTION 26 24 16

SECTION 26 27 16 - CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install cabinets for panelboards, telephone, and communication systems as required.

1.3 RELATED WORK IN OTHER SECTIONS

- A. Panelboards, sound systems, telephone systems.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Sheet steel code gauge, galvanized cabinets with painted fronts and trim. Those exposed to wet or rain conditions shall be "raintight" unless otherwise noted. Cabinets without through feeder wiring shall be arranged to provide a wiring gutter not less than 4 inches wide for branch circuit panelboards served by feeders up to 4/0. Panelboards served by feeders in excess of 4/0, up to and including 750 kcmil, shall be provided with top, bottom and side gutters 8 inches wide. Cabinets shall be of standard make and shall bear the Underwriters Laboratories label. All outside surfaces of trim and doors shall be given a factory finish coat of No. 61 ANSI gray paint, or approved manufacturer's standard. Cabinets for telephone and communications systems shall have 5/8-inch exterior grade, one-face B-grade or equal flame proofed plywood backboard inside with maximum height and width.

2.2 FEED-THROUGH GUTTERS

- A. Where feeders go through panelboard cabinets to serve panelboards above or beyond, the wiring gutters in panelboard cabinets shall be a minimum of 8 inches on sides, top and bottom.

2.3 TRIM

- A. One-piece, sheet steel trim with hinged door with catch and lock. One-piece sheet steel with 3/4-inch flange around all edges shaped to cover edge of box. For telephone or communication cabinets trims with captive nuts or clamps. Trims shall be furnished with indicating adjustable trim clamps for panelboards.

2.4 DOORS

- A. Doors shall close against a rabbet placed all around the inside edge of the frame with a close-fitting joint between door and frame. The doors shall be fitted with substantial flush hinges placed not over 24 inches apart, nor more than six inches from ends of doors, and fastened permanently to the door and frame with round-headed rivets or spot welds, or with concealed flush piano hinges. Fastening screws or clamps or trims shall be set not over 24 inches apart. Doors over 48 inches in height shall be equipped with a vault handle and a three-point catch.

2.5 LOCKS

- A. Furnish each cabinet with a combination catch and flat key lock. The telephone, electrical and signal cabinet locks shall be fitted to separate keying for each system. Furnish two keys for each cabinet.

2.6 GROUND BAR

- A. Each cabinet, for a panelboard, shall be provided with a copper interior ground bar suitably braced or bolted to the cabinet wall. The equipment ground bar shall be equivalent in current carrying capacity to the incoming feeder ground conductor and shall have approved pressure connector terminations for the associated feeders, branch circuits, etc.

PART 3 - EXECUTION

3.1 CABINETS

- A. Cables installed in the wiring gutters of cabinets shall be neatly bundled, routed, and supported. Minimum bending radii as recommended by the cable manufacturer shall not be reduced. Lighting and power cabinets shall be installed with tops 6'-6" above floor and bottoms not less than 12 inches above floor.

END OF SECTION 26 27 16

SECTION 26 27 26 - WIRING DEVICES AND PLATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions for the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install all wiring devices and plates as required for the complete installation and operation of all systems throughout the project.

1.3 RELATED WORK IN OTHER SECTIONS

- A. Conductors, Conduit, Boxes and Fittings.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Unless otherwise specified, each wall switch (flush tumbler-toggle) shall be of the A.C. General use type for mounting in a single gang spacing, fully rated 20 amperes minimum at 120/277 volts, conforming to minimum requirements of the latest revision of the Underwriter's Laboratories, Inc., UL 20 Fifth Edition Standard Snap Switches, and further requirements herein specified. Specification grade, heavy duty, single pole, 3-way or 4-way, of the maintained, momentary or lock type as indicated on the drawings. Switches shall operate in any position and shall be fully enclosed cup type with entire body of molded phenolic, urea or melamine with cover of molded phenolic, urea or melamine. Fiber, paper, or similar insulating material shall not be used for body or cover. Ivory color handles unless otherwise indicated. Silver or silver alloy contacts. A.C. 120/277-volt general use snap switches shall be capable of withstanding tests as outlined in NEMA Publications and shall be as follows unless otherwise noted:

Switch	Hubbell	P & S	Bryant	Leviton
1P	1221-I	20-AC-1-I	4901-I	1221-I
2P	1222-1	20-AC-2-I	4902-I	1222-I
3-Way	1223-I	20-AC-3-I	4903-I	1223-I
4-Way	1224-I	20-AC-4-I	4904-I	1224-I
3-pos. 2 cct maintained	1385-I	1225-I	4922-I	
3-pos. 2 cct momentary	1557-I	1251-I	4921-I	
Lighted handle pilot lgt.	1221-PL	2251-SP	4901-PL	1220-PL

2.2 RECEPTACLES

- A. General: Configuration and requirements for all connector or outlet receptacles shall be in accordance with NEMA Publications. Fire resistant, non absorptive, hot welded, phenolic composition or equal bodies and bases with metal plaster ears (integral with the supporting member). Single or duplex as shown or noted on drawings. Ivory color unless otherwise noted on the drawings. Double grip contacts for each prong.
- B. Grounding Type: All receptacles shall be grounding type with a green colored hexagonal equipment ground screw of adequate size to accommodate an insulated grounding jumper (based on Table 250-95 of the NEC with minimum size No. 14 AWG). Grounding terminals of all receptacles shall be internally connected to the receptacle mounting yoke. Unless otherwise noted, receptacles shall be as follows:

Receptacle	Hubbell	P & S	Bryant
20A-125V AC 2P 3W	5362-I	6300-I	5362-I
20A-208V AC 4P 4W	7250	7250	7250
30A-250V AC 3P 3W	9350	L1030R	9303
30A-600V AC 4P 4W	3430	3430	3430
Special	Receptacles for special applications shall be as indicated on the drawings.		

- C. Load Controllable Type:
 - 1. Meet all aspects already detailed in specifications.
 - 2. Permanent controlled markings on face of receptacle compliant with ASHRAE 90.1, CA Title 24, and NEC.
 - 3. Half-controlled versions include welded, pre-wired lead that control top half of receptacle for split circuit applications.
 - 4. Refer to plans for specific model and control options.

2.3 PLUG CAPS

- A. Except for duplex receptacles, and cleaning combination receptacles one matching plug cap shall be provided for each receptacle. No plug caps are required for duplex receptacles. Provide watertight, male plug caps in damp locations or where exposed to weather.

2.4 DEVICE PLATES

- A. General: Provide plates for each switch, receptacle, signal and telephone outlet and special purpose outlet. Do not use sectional gang plates. Provide multi gang outlet plates for multi gang boxes. All plates on finished walls shall be Leviton #84000-40 series, stainless steel. Screws shall be of metal with countersunk heads with finish to match the finish of the plate. Device plates shall be of the one-piece type, of suitable shape for the device to be covered.

- B. Exposed: Plates for exposed screw jointed fittings shall match the fittings with edges of plates flush with edges of fittings. To be heavy cadmium plates, steel, with gasket. Plates for cast type boxes at locations subject to wet or rain conditions, shall be of the cast, vapor tight type. Provide hinged lift covers for devices.
- C. Communications: Plates for telephone and signal outlets shall each have a 3/8-inch bushed opening in the center. Wall plates for push button and buzzer outlets shall have openings to suit the push buttons and buzzers.
- D. Plates for special purpose outlets shall be of a design suitable for the particular application.

2.5 CLOCK OUTLETS

- A. Flush, single receptacle, regressed in stainless steel device plat.

2.6 REMOTELY CONTROLLED SWITCHES OR RELAYS

- A. Electro-magnetically operated, mechanically held with clearing contacts for maintained contact control unless otherwise required. Rugged construction conforming to NEMA and IEEE test standards for industrial type power relays and the requirements of UL 508, Standards for Safety Industrial Control Equipment. Ratings as indicated on the drawings suitable for the application. Contacts shall be double break renewable, solid wiping type, silver-to-silver Tungsten alloy, self-aligning, quick-make, quick-break, with a minimum inductive load rating of 20 amps. Relays shall be as manufactured by Allen-Bradley, Cutler-Hammer, General Electric, Square D or Westinghouse, equal to Allen-Bradley Bulletin 700 Control Relays. Provide sound deadening mounting and enclosure.

2.7 MOMENTARY CONTACT SWITCHES

- A. Tumbler type single pole double throw momentary contact for 3 wire circuit, with Off position when tumbler handle is in the center, similar in appearance to the conventional snap switch. Handle or key operated as indicated on drawings. 15 amperes at 120/277 volts for control of 30, 60, or 100 ampere remotely controlled switches or relays rated 101 amperes and above. Provide nameplate to identify the circuit or equipment controlled.

PART 3 - EXECUTION

3.1 OUTLET LOCATIONS

- A. Shall be as indicated on the drawings. Align devices and plates horizontally and vertically.
- B. It shall be the responsibility of the Contractor to determine from the architectural drawings and by actual determination on the site, the exact location of each and every outlet. The outlet locations shall be modified from those shown on the plans to accommodate changes in door swings or to clear other interferences that may arise from job construction details as well as modifications within room spaces. These modifications shall be made with no change in contract price and shall be a matter of job coordination

at the expense of the Contractor. The Contractor shall check these conditions throughout the entire job and shall notify the Architect/Engineer of discrepancies as they occur before proceeding with the installation of the work to verify the modifications, if any. Wall boxes shall be set in advance of wall construction, shall be blocked in place and secured. All wall boxes shall be set flush with finished building construction and the Contractor shall furnish and install extension sleeves as required to extend boxes to the finished surfaces of special furring. No switches shall be located behind doors without specific written authorization by the Architect.

3.2 YOKES

- A. Wiring device yokes shall be installed in physical contact with the plaster ring. Where the above contact cannot be obtained, a green covered bonding conductor shall be installed.

3.3 PLATES

- A. Shall be installed with all four edges in continuous contact with finished wall surface without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed vertically and with an alignment tolerance of 1/16".
- B. Device cover plates for each and every device shall be furnished and installed by this Contractor.

3.4 RECEPTACLES

- A. Shall have a separate ground wire from the grounding screw to a grounding stud in the outlet box. All receptacles shall be installed with the "U" slot in the upper position. Substitutions for duplex convenience outlets as listed in 16140 - 2.2 shall only be considered if rated as "Specification Grade".

END OF SECTION 26 27 26

SECTION 26 28 00 - MOTOR AND CIRCUIT DISCONNECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install complete motor and circuit disconnects for various items requiring them for this project.

1.3 RELATED WORK IN OTHER SECTIONS

- A. Conductors, motors, motor starters, motor control centers, panelboards, grounding.

PART 2 - PRODUCTS

2.1 DISCONNECTING MEANS

- A. Safety Switches: Fusible Type HD quick break safety switches of the sizes and capacities indicated or required. NEMA 4 Raintight enclosures at locations exposed to the weather.
- B. Separately Enclosed Motor Snap Switches: Motor snap switches may be used for motor disconnect means, controller, and motor overcurrent protection when applicable. These devices shall be horsepower rated and shall contain motor running overcurrent protection.

2.2 SAFETY TYPE DISCONNECTING SWITCHES

- A. Heavy duty, quick make, quick break type, 250-, 480- or 600-volt rating as required for the application. Number of poles and ampacity as noted or required for application or required by code. Fusible with fuse clips suitable for Buss fuses. Short circuit rating of 200,000 RMS Amperes with Class R rejection feature installed in fuseholders. NEMA 1 enclosures for dry locations. NEMA 4 enclosures for wet locations or where exposed to weather unless otherwise noted.
- B. Fuses shall be provided for all switches. Fuses for switches at motors shall be Bussman Fusetrans, sized for heavy service motor running protection. Fuses in other locations shall be as designated on the drawings or indicated in Section 262813 of these specifications. Proper fuse amp ratings shall be indicated on inside of switch cover, through the use of "Tapewriter" and should read "Use Fusetrans Only" (indicate amperage size as shown on plans). See Section 262813 for other labeling requirements.

PART 3 - EXECUTION

3.1 DISCONNECT MEANS

- A. Install in each location indicated on the drawings and elsewhere as required by NEC.
- B. Switches installed outdoors shall be raintight and shall be suitably supported, independently of the item to be served (by unistrut rack) unless sufficient unobstructed flat surface exists on the unit to properly support the electrical equipment.

END OF SECTION 26 28 00

SECTION 26 29 00 - MOTOR STARTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install all motor starters, complete as required.

1.3 RELATED WORK IN OTHER SECTIONS

- A. Grounding, Controls and Instrumentation, Motor Control Centers.

1.4 SUBMITTALS

- A. Submit complete shop drawings, control diagrams and descriptive literature.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Starters shall be as specified in this section unless modified by other sections of these specifications or by details or control diagrams on the drawings. Provide NEMA Type I general purpose enclosures, unless otherwise noted or required, with doors arranged for padlocking. Equip starters with contactors to break each ungrounded line to the motor.

2.2 RATING

- A. Each starter shall have a horsepower rating not less than the rating of the motor it controls. Starters and all their related component parts shall be designed and properly coordinated for the rating and characteristics of the motors furnished under the various sections of these specifications. Motor starters and overcurrent devices shall be ambient temperature compensated.
- B. All starters sized for motors 25 HP or larger shall be reduced voltage starters unless otherwise indicated.
- C. All reduced voltage starters shall be auto-transformer type unless otherwise indicated.

2.3 OVERLOADS

- A. Provide ambient temperature compensated thermal over current devices in each phase. Provide a suitable reset device for resetting over current trip on the starter front. Overcurrent device ratings shall not exceed code maximums and shall be as recommended by the motor manufacturer for the application.

2.4 CONTROLS

- A. Control circuit conductors shall be grounded in accordance with the NEC and shall be arranged so that an accidental ground will not start the motor.
- B. Energy for control circuits and indicating lights shall be 120 volts.
- C. Provide manual start-stop pushbuttons mounted in starter case unless automatic devices are shown on drawings or specified.
- D. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic control device does not have such a rating, a magnetic starter shall be used, with the automatic control device actuating the pilot control circuit.
- E. Starters controlled by automatic devices shall be provided with hand-off automatic selector switch mounted on starter case and connected so motor can be manually operated regardless of the position of the automatic control device. Selector switch shall not be connected to supersede any safety device or safety interlock.
- F. Provide starters with a sufficient number of auxiliary contacts (N.O. and/or N.C.) to afford the control and interlocking required. Provide additional relays if required to obtain the correct control.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide each motor with a motor starter of proper design to meet the requirements of the motor and drive.

3.2 INSTALLATION

- A. Install and connect in accordance with related work specified in other sections of these specifications and standard industry practice.

END OF SECTION 26 29 00

SECTION 26 43 00 - SURGE SUPPRESSION PROTECTION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The specified unit shall provide effective high energy transient voltage suppression, surge current diversion, high frequency attention and line control for all electrical modes of equipment connected downstream from the facility's meter or main overcurrent device in the afore mentioned ANSI/IEEE C62. 41-1991 environment(s). The unit shall be connected in parallel with the facility's wiring system.
- B. The unit shall be designed and manufactured in the USA by a qualified manufacturer of suppression filter system equipment. The qualified manufacturer shall have been engaged in the commercial design and manufacturer of such products for minimum of ten (10) years.

1.2 ENVIRONMENTAL REQUIREMENTS

- A. Storage Temperature. Storage temperature range shall be -40 to + 85 C" (-40 to +185F).
- B. Operating Temperature. Operating temperature range shall be -40 to +140F).
- C. Relative Humidity. Operation shall be reliable in an environment with 5% to 95% non-condensing relative humidity.
- D. Operating Altitude. The unit shall be capable of operation in altitudes up to 13,000 feet above sea level.
- E. Audible Noise. The unit shall not generate any audible noise.
- F. Magnetic Field. No appreciable magnetic fields shall be generated. Unit shall be capable of use directly in computer rooms in any location without danger to data storage systems or devices.

1.3 RELATED DOCUMENTS AND APPLICABLE STANDARDS

- A. Systems shall be designed, manufactured, tested and installed in accordance with the following standards:
 - 1. Underwriters Laboratories (UL 1449, 2nd addition)
 - 2. Canadian Standard Association (CSA)
 - 3. National Electrical Manufacturers Association (LS-1-1992, 2.2.9 and 3.9)
 - 4. American National Standards Institute
 - 5. Institute of Electrical an Electronic Engineers (C62.41 and C62.45)
 - 6. Military Standards (SIL-STD 220A)
 - 7. National Electric Code (Article 280)
 - 8. National Fire Protection Association (NFPA-78)
 - 9. Federal Information Processing Standards Publication (FIPS PUB 94)
 - 10. Underwriter's Laboratory 248-1 individual MOV fusing requirements.

11. Items 1 and 2 shown above shall also include industry recognized independent test data, showing the equipment has passed these tests. A copy of these results shall be included with the approval package.

1.4 TRANSIENT VOLTAGE SURGE SUPPRESSION

- A. System shall be tested to meet ANSI/IEEE C62.41-1991, tested per ANSI/IEEE C62.45-1992.
- B. The system shall be tested to 1,000 sequential ANSI/IEEE C62.41 Category C waveforms.
- C. The system shall be tested to UL1283 for electrical line noise attenuation. A minimum of 8 points shall be shown for specific db attenuation over frequency range of 50KHz - 100MHz.

1.5 WORK INCLUDED

- A. Transient Voltage Surge Suppression (TVSS) System

1.6 SUBMITTALS FOR REVIEW

- A. Section 260500 – SUBMITTALS
- B. Product Data: Provide shop drawings for all devices utilized.

PART 2 - PRODUCTS

2.1 UNIT OPERATING VOLTAGE

- A. The nominal unit operating voltage and configuration shall be as indicated on the drawings.

2.2 MAXIMUM CONTINUOUS OPERATING VOLTAGE (MCOV)

- A. The maximum continuous operating voltage (MCOV) of all suppression components utilized in the unit shall not be less than 115% of the facility's nominal operating voltage.

2.3 SERVICE ENTRANCE PANELS

- A. Unit shall be rated Category C3 location per ANSI/IEEE C62.41-1991.
- B. The tested single-pulse surge current capacity, in amps, of the unit, based on ANSI/IEEE C62.41-1991's standard 8X20 microsecond current waveform, and in accordance with NEMA Publication No. LS 1-1992, shall be no less than as follows:
- C. Mode of Protection L-LL-NL-GN-GT
Tested Single Pulse Surge Current 150,000 150,000 150,000 150,000

- D. Unit shall have individually fused MOV's, with the fusing designed to operate only in the event of a fault within the TVSS. In the event of a fuse operating, the remaining fuses shall stay online to protect the system.
- E. The unit's published performance ratings shall be the UL 1449 Listed suppression ratings. The UL 1449 suppression rating shall be, for each mode of protection, as follows:
- F. Nominal System VoltageL-NL-GN-
G120/208400/450400/500450/425277/480850/850825/850875/825347/6001000/12001000/12001000
1. Note: Numbers following slash indicate UL 1449 suppression rating for models with integral disconnect switch.
 2. The unit shall include a high frequency extended range tracking filter and shall be UL 1283 Listed as an Electromagnetic Interference Filter.
 3. The unit shall include mechanical lugs for each phase, neutral and ground, if applicable. The lugs shall accommodate up to #2 AWG copper conductor with integral disconnect switch and up to 1/0 AWG copper conductor without integral disconnect switch.
 4. Units shall be provided in a NEMA 1 type enclosure of 14-gauge steel. Dimensions shall not be greater than 22" wide by 38" high by 12" deep. Weight shall not exceed 100 lbs. (max).
- G. Accessories
1. Integral Disconnect Switch
 - a) The unit shall include an integral safety interlocked disconnect switch located in the unit enclosure with an externally mounted manual operator. The switch shall be rated for 600 Vac. Specify "DM" suffix.
 2. On-Line Metering
 - a) The unit shall include an integral multifunction power monitor analyzer. The multimeter shall provide real-time product performance via multiport visual status indicators (LED's) and a touchpad accessible LED data display. The Following features shall include:
 - 1) Enhanced Status Indicators. At the touch of a button, the indicators shall show the following data:
 - (a) %protection available from the TVSS system.
 - (b) Neutral to Ground fault indication.
 - (c) Neutral to Ground current sensing.
 - (d) True RMS voltage of system connected.
 - (e) Voltage sag detection. (Any voltage sag<90% of nominal)
 - (f) Voltage swell detection. (Any voltage swell >110% on nominal)
 - (g) Power dropout detection. (Any voltage dropout of <1 cycle)
 - (h) Power outage detection. (Any voltage outage of >1 cycle)

- 2) Dual form C contacts (normally open and normally closed design).
- 3) Display event counter.
- 4) Battery powered audible alarm. (Can be defeated on the front panel)

2.4 DISTRIBUTION PANELS/PANELBOARDS/VFD'S

- A. Unit shall be rated Category B3 location per ANSI/IEEE C62.41-1991.
- B. The tested single-pulse surge current capacity, in amps, of the unit, based on ANSI/IEEE C62.41-1991's standard 8X20 microsecond current waveform, and in accordance with NEMA Publication No. LS 1-1992, shall be no less than as follows:

Mode of Protection	L-LL-NL-GN-G	Per Phase	Tested single Pulse Surge Current
	100,000	100,000	100,000
	200,000	200,000	200,000
- C. Mode of Protection L-LL-NL-GN-G Per Phase Tested single Pulse Surge Current 100,000 100,000 100,000 200,000
- D. Unit shall have indicator status lights for the TVSS device, verifying proper operation.
- E. The unit's published performance ratings shall be the UL 1449, 2nd edition, Listed suppression ratings. The UL 1449 suppression rating shall be, for each mode of protection, as follows:
 1. Nominal System Voltage L-NL-GN-G
G120/208400/450400/500450/425277/480850/850825/850875/825347/6001000/
12001000/12001000
 - a) Note: Numbers following slash indicate UL 1449 suppression rating for models with integral disconnect switch.
- F. The unit shall include a high-frequency extended range-tracking filter and shall be UL 1283 Listed as an Electromagnetic Interference Filter.
- G. The unit shall include mechanical lugs for each phase, neutral and ground, if applicable. The lugs shall accommodate up to #8 AWG copper conductor with integral disconnect switch and up to 1/0 AWG copper conductor without integral disconnect switch.
- H. Units shall be provided in a NEMA 1 type enclosure of 14-gauge steel. Dimensions shall both be greater than 13" wide by 24" high by 8" deep. Weight shall not exceed 40 lbs. (max).
- I. Accessories
 1. Integral Disconnect Switch
 - a) The unit shall include an integral safety interlocked disconnect switch located in the unit enclosure with an externally mounted manual operator. The switch shall be rated for 600 Vac. Specify "DM" suffix.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The specified system shall be installed no further than ten (10) feet in total wire lead length distance from the service entrance bus, distribution panelboard bus or variable frequency drive it is protecting and shall avoid any unnecessary bends. Insulated conductors shall be provided for all necessary power and ground connections.
- B. System shall be complete, including status indicator lights providing independent protection circuit status.
- C. Other materials and equipment shall comply with applicable Sections of this Division.

3.2 WARRANTY

- A. Manufacturer shall provide a product warranty for (5) five years from date of installation. Warranty shall cover unlimited replacement of system components during the warranty period.

3.3 QUALITY ASSURANCE

- A. Those firms responding to this specification shall provide proof that they have been regularly engaged in the design and manufacturing for at least 10 years.
- B. Start-Up Testing. Upon completion of installation, a factory-certified local service technician shall provide testing services. The following tests shall be performed: (a) voltage measurements from Line-to-Ground, Line-to-Neutral, Line-to-Line and Neutral-to-Ground (no neutral in DELTA configurations) at the time of the testing procedure, (b) impulse injection to verify the system suppression voltage tolerances for all suppression paths. A copy of the start-up test results, and the factory benchmark testing results shall be supplied to the engineer and the owner for confirmation of proper suppression filter system function. In addition, the integrity of the neutral-ground bond should be verified through testing and visual inspection. A Seven-Year Limited Warranty shall initiate after the owner has accepted the testing results and taken possession of the equipment.

END OF SECTION 26 43 00

SECTION 26 51 19 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.

1.2 RELATED WORK IN OTHER SECTIONS

260500 GENERAL ELECTRICAL PROVISIONS
260519 CONDUCTORS
260526 GROUNDING
260533 RACEWAYS, BOXES AND FITTINGS
262726 WIRING DEVICES AND PLATES

1.3 SECTION INCLUDES:

- A. Interior solid-state luminaires that use LED technology.
- B. Lighting fixture supports.
- C. Construction and installation requirements.

1.4 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire".
- D. IP: International Protection of Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.5 SUBMITTALS

- A. Product Data: For each type of product, arranged by designation.
- B. Product Schedule: For luminaires and lamps. Use same designation indicated on Drawings.
- C. Refer to Section 260500 for additional requirements.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Product Certificates: For each type of luminaire.
- C. Sample warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Recessed Fixtures: Comply with NEMA LE 4.
- C. CRI and CCT shall be as scheduled on contract documents.
- D. Rated lamp life of 50,000 hours.
- E. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- F. Internal driver.
- G. Nominal Operating Voltage: as specified on the drawings.
- H. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Clear powder-coat finish.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.2 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.

2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.
- C. Diffusers and Globes:
1. Prismatic acrylic.
 2. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 3. Lens thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
1. Extruded-aluminum housing and heat sink.
 2. Clear powder-coat finish.

2.3 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 “Hangers and Supports for Electrical Systems” for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: ½-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12-gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports: Sized and rated for luminaire weight.

- E. Flush-Mounted Luminaire Support: Secured to outlet box.
- F. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length. Brace to limit sway or swinging.
- G. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging or sway.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
- L. Comply with requirements in Division 26 for Power Conductors and Cables for wiring connections.
- J. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 for Identification for Electrical Systems.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare Test and inspection reports.

END OF SECTION 26 51 19

SECTION 32 1123 - AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.
- B. Paving aggregates.

1.02 RELATED REQUIREMENTS

- A. Perform all work in accordance with the American Public Works Association New Mexico Chapter, New Mexico Standard Specifications for Public Works Construction (Latest Edition).
- B. Section 31 2200 - Grading: Preparation of site for base course.
- C. Section 31 2323 - Fill: Compacted fill under base course.
- D. Section 32 1216 - Asphalt Paving: Binder and finish asphalt courses.

1.03 REFERENCE STANDARDS

- A. Perform all work in accordance with the American Public Works Association New Mexico Chapter, New Mexico Standard Specifications for Public Works Construction (Latest Edition).
- B. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; American Association of State Highway and Transportation Officials; 1965 (2004).
- C. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010.
- D. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2006.
- E. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- F. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- G. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- H. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- I. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- J. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

- K. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- L. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When aggregate materials need to be stored on site, locate stockpiles where indicated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.
- C. Verify that survey bench marks and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide material in accordance with the American Public Works Association New Mexico Chapter, New Mexico Standard Specifications for Public Works Construction (Latest Edition).

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- B. Level and contour surfaces to elevations and gradients indicated.

- C. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 32 1216 - ASPHALT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aggregate base course.
- B. Single course bituminous concrete paving.
- C. Double course bituminous concrete paving.
- D. Surface sealer.

1.2 RELATED REQUIREMENTS

- A. Perform all work in accordance with the American Public Works Association New Mexico Chapter, New Mexico Standard Specifications for Public Works Construction (Latest Edition).
- B. Section 31 2200 - Grading: Preparation of site for paving and base.
- C. Section 31 2323 - Fill: Compacted subgrade for paving.

1.3 REFERENCE STANDARDS

- A. Perform all work in accordance with the American Public Works Association New Mexico Chapter, New Mexico Standard Specifications for Public Works Construction (Latest Edition).
- B. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1997.
- C. AI MS-19 - A Basic Asphalt Emulsion Manual; The Asphalt Institute; Fourth Edition.
- D. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.

1.4 QUALITY ASSURANCE

- A. Perform all work in accordance with the American Public Works Association New Mexico Chapter, New Mexico Standard Specifications for Public Works Construction (Latest Edition).
- B. Mixing Plant: Provide material in accordance with the American Public Works Association New Mexico Chapter, New Mexico Standard Specifications for Public Works Construction (Latest Edition).
- C. Obtain materials from same source throughout.

1.5 REGULATORY REQUIREMENTS

- A. Perform all work in accordance with the American Public Works Association New Mexico Chapter, New Mexico Standard Specifications for Public Works Construction (Latest Edition).

- B. Conform to applicable code for paving work on public property.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Aggregate for Base Course: Provide material in accordance with the American Public Works Association New Mexico Chapter, New Mexico Standard Specifications for Public Works Construction (Latest Edition)..
- B. Obtain materials from quarries located within a 500 mile radius of project site.

2.2 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Provide material in accordance with the American Public Works Association New Mexico Chapter, New Mexico Standard Specifications for Public Works Construction (Latest Edition).

2.3 SUBMITTALS

- A. Mix design

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.2 BASE COURSE

- A. Place and compact base course.

3.3 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Perform all work in accordance with the American Public Works Association New Mexico Chapter, New Mexico Standard Specifications for Public Works Construction (Latest Edition).
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Install gutter drainage grilles and frames in correct position and elevation.
- D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.4 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

- A. Place asphalt binder course within 24 hours of applying primer or tack coat.

- B. Place wearing course within two hours of placing and compacting binder course.
- C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- D. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.5 SEAL COAT

- A. Apply seal coat to surface course and asphalt curbs in accordance with AI MS-19.

3.6 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/2 inch.

3.7 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for quality control.
- B. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.

END OF SECTION

SECTION 32 13 13 - CONCRETE PAVING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK DESCRIBED ELSEWHERE

- A. Division 03 Section “Cast in Place Concrete”.
- B. Division 31 Section “Earthwork”.

- 1.3 DESCRIPTION OF WORK: Extent of Portland cement concrete paving is shown on drawings. Installation includes curbs, gutters, walks, slab on grade type paving and miscellaneous paved areas. Unless otherwise specified or indicated on the plans, the minimum thickness of walks shall be 4". The minimum thickness of gutters, driveway aprons, and inter- sections shall be 6" unless otherwise shown on the plans. The height and thickness of curb sections are shown on the plans.

- 1.4 QUALITY ASSURANCE: Comply with local governing regulations if more stringent than herein specified.

1.5 SUBMITTALS

- A. Furnish samples, manufacturer's product data, test reports, and materials certifications as required in referenced sections for concrete and joint fillers and sealers.

1.6 JOB CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Utilize barricades, warning signs & warning lights as required

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Forms: Steel, wood or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removed. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with a nonstaining form release agent that will not discolor or deface surface of concrete.
- B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric ASTM A185. May be furnished in rolls for use in portland cement concrete paving. Metal chairs or trusses must be used to position mesh in slab unless indicated otherwise.
- C. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 40.
- C. Concrete Materials: Comply with requirements of applicable Division 3 sections for concrete materials, admixtures, bonding materials, curing materials, and others as required.
 - 1. Provide standard grey cement, to provide an initial SRI of .33 and an aged

value of .28 (three years).

- E. Joint Materials
 - 1. Comply with requirements of applicable Division 07 sections for expansion joint fillers and sealers.
 - 2. Use one-compartment polyurethane Type I (self-leveling) sealant, color as selected by Architect from manufacturer's complete range of color samples.
 - 3. Key joint material of 22 gauge galvanized steel.
 - 4. Expansion joint filler, gray in color. Provide preformed profiles for gutters, etc. Approved manufacturer is Homosote "Homex 300" or equal.
 - a. Provide "zip strips" or other suitable means of holding down expansion joints at walkways for installation of sealant.
- F. Curing Compounds: In addition to other required curing methods, provide clear water borne membrane forming curing compound at indicated locations. Comply with ASTM C309, Type I, Class B.
- G. Epoxy Resin Grout: FS MMM-G-650.
- H. Joint Dowel Bars: Plain steel bars, ASTM A615, Grade 60. Cut bars true to length with ends square and free of burrs.
- I. Metal Expansion Caps: Furnish for one end of each dowel bar in expansion joints. Design caps with one end closed and a minimum length of 4" to allow bar movement of not less than 1", unless otherwise indicated.

2.2 CONCRETE MIX, DESIGN, TESTING

- A. Comply with requirements of applicable Division 03 sections for concrete mix design, sampling and testing, and quality control, and as herein specified.
- B. Design mix to produce standard weight concrete consisting of portland cement, aggregate, air-entraining admixture and water to produce the following properties.
 - 1. Compressive Strength: 4000 psi, minimum 28 days.
 - 2. Slump Range: 2" to 4".
 - 3. Entrained Air Content: 5% to 8%.
 - 4. Integral Color: Provide where indicated.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Proof-roll prepared subbase surface to check for unstable areas and need for additional compaction. Do not begin the paving work until such conditions have been corrected and are ready to receive paving.

3.2 FORM CONSTRUCTION

- A. Set forms to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow for continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

- B. All curb and combined curb and gutter shall be divided into blocks or stones in lengths not to exceed 6'-0" long using metal templates not less than 1/16" nor more than 1/4" thick cut to same cross section as curb or curb and gutter being constructed. Templates shall be securely attached to forms to prevent movement during concrete placement.
 - C. Forms, except curb back planks, shall be set with upper edges thereof flush with specified grade of finished surface of adjacent portion of work and shall be not less than a depth equivalent to full specified depth of thickness of the concrete to be supported thereby.
 - D. Back forms shall be held securely in place by means of stakes driven in pairs, one at front form and one at back, at intervals not to exceed 4'-0"; clamps, spreaders, and braces being used in connection therewith to such extent as may be necessary to insure proper rigidity of forms. Forms for walks, gutters, and similar work shall be firmly secured by means of stakes driven flush with upper edge of forms at intervals not to exceed 5'-0". Stakes shall be of sufficient size and shall be so driven as to properly and adequately support the forms.
 - E. Form clamps, specifically designed and manufactured for the curb and gutter to be constructed, may be used if, in the opinion of the Architect, they fulfill requirements herein-above specified for curb and gutter forms.
 - F. Check completed formwork for grade and alignment to the following tolerances.
 - 1. Top of forms not more than 1/8" in 10 feet.
 - 2. Vertical face on longitudinal axis not more than 1/4" in 10 feet.
 - G. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.
- 3.3 REINFORCEMENT: Provide minimum 6X6 10/10 welded wire fabric in all walks and paving unless otherwise noted. Locate, place and support reinforcement as specified in Division 03 sections, unless otherwise indicated.
- 3.4 CONCRETE PLACEMENT
- A. General: Comply with requirements of Division 03 sections for mixing and placing concrete and as herein specified.
 - B. Do not place concrete until subbase and forms have been checked for line and grade.
 - C. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment. Surfaces of structures in sidewalks, curbs, and gutters shall be adjusted as necessary prior to placing of concrete to meet the contiguous sidewalk surfaces.
 - D. Concrete shall be placed on a thoroughly dampened subgrade sufficiently moist to ensure that no moisture will be absorbed from the fresh concrete.
 - E. Concrete shall be placed in horizontal layers not to exceed 6" each in thickness, each layer being spaded along forms and thoroughly tamped. However, if section is more than 6" deep, concrete may be placed to provide thickness shown or specified, if mechanical interval vibrators are used or if, in Architect's opinion, spading and tamping is sufficient to consolidate concrete for its entire depth.
 - F. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, and/or side forms. Use only square-faced shovels for hand-spreading

& consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, & joint devices.

1. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place a construction joint.
- G. After concrete has been placed between side forms, a strike-off shall be used to bring surface to proper section to be compacted. It shall then be spaded along form faces and tamped with appropriate tampers not less than two times in order to assure a dense and compact mass, forcing larger aggregate into body thereof and bringing to surface sufficient free mortar for finishing.
- H. After concrete has been placed and tamped, upper surface shall be struck off uniformly smooth and true to specified grade.

3.5 JOINTS

- A. General: Construct expansion, isolation, weakened-plane (contraction) and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated. Where load transfer slip dowel devices are used, install so that one end of each dowel bar is free to move.
- B. Weakened Plane (Contraction) Joints: Provide weakened plane (contraction) joints, sectioning concrete into areas as shown on drawings. Where continuous curb and gutter is constructed adjacent to cement concrete pavement, weakened plane joints shall be installed continuous with alternate joints installed in adjacent pavement, in which case no expansion joints for sidewalks shall be placed at intervals not exceeding 18 feet with joint filler strips. Construct weakened plane joints for a depth equal to at least 1/4 of concrete thickness, as follows.
1. Tooled Joints: Form weakened plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.
 2. Inserts: Use embedded strips of metal or sealed wood to form weakened plane joints. Set strips into plastic concrete and carefully remove strips after concrete has hardened.
- C. Construction Joints: Place construction joints at end of pours at locations where placement operations are stopped for a period of more than 1/2 hour, except where such pours terminate at expansion joints. Construct joints as shown, or if not shown, use standard metal keyway section forms.
- D. Expansion Joints: Provide premolded gray color joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, walks and other fixed objects unless otherwise indicated. No such joints shall be constructed in cross gutters, alley intersections or driveway aprons. Expansion joint filler strips shall be placed in walks at PT and PC of all walk returns, in wall returns between walk and back of curb returns, and around all utility poles encountered along the line of work.
1. Unless otherwise shown on plans or standard drawings, 1/2" joints shall be constructed in curbs and gutters at end of all returns except where cross gutters are being constructed. They shall be at ends of cross gutter transitions and also along line of work at regular intervals of every sixth stone but not to exceed 36 feet and joints in gutter being continuous with those in adjacent curb.
 2. Unless otherwise indicated, arrange expansion joints in slab on grade paving to limit maximum panel dimension to 36 ft. or 200 sf, whichever is smaller.
 3. Extend joint fillers full width and depth of joint and not less than 1/2" or more than 1"

- below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
4. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.
 5. Protect top edge of joint filler during concrete placement with metal cap or other temporary material. Remove protection after concrete has been placed on both sides of the joint.
- E. Isolation Joints: Provide premolded joint filler for isolation joints abutting walls, columns, and other fixed structures.
1. Extend joint filler full width and depth of joint, not less than 1/2" nor more than 1" below finished surface where joint sealer is indicated. If no joint sealer indicated, place top of joint filler flush with finished concrete surface.
 2. Extend bond breaker full width and depth of one side of premolded joint filler.
 3. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.
 4. Protect top edge of joint filler during concrete placement with metal cap or other temporary material. Remove protection after concrete has been placed on both sides of the joint.
- F. Fillers and Sealants: Comply with requirements of applicable Division 7 sections for preparation of joints, materials, installation and performance.

3.6 CONCRETE FINISHING

A. General

1. After striking off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
2. After floating, test surface for trueness with a 10-foot straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.
3. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2" radius unless otherwise indicated. Eliminate the tool marks on concrete surfaces.
4. After completion of floating and where excess moisture or surface sheen has disappeared, complete surface finishing as follows.
 - a. Non-Slip Broom Finish: Apply non-slip broom finish to exterior steps and ramps only. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
 - b. Broom Finish: Finish by drawing a fine-hair broom across concrete surface, perpendicular to line of traffic. Repeat operation if required to provide a fine line texture acceptable to the Architect.
 - c. Tooled Edge Bands:
 - 1) Provide 4" tooled smooth edge bands at walk areas indicated. See Drawings for scope and details.
5. Do not remove forms for 24 hours after concrete has been placed. After form removal,

clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by the Architect.

B. Curb

1. The front forms may be stripped as soon as concrete has sufficiently set, but must be removed before expiration of six hours after pouring.
2. Face and top of curb shall then be carefully troweled to a smooth and even finish, top being finished to a transverse slope of 1/4" toward front, with both edges rounded to a radius of 3/4". Troweled surface shall be finished with a fine hair broom parallel with line of work.

C. Walk / Ramp

1. Following placing of concrete, surface shall be worked to a true and even grade, free from waves and irregularities. After preliminary troweling, initial scoring for block markings shall be made to a depth of 1" in order to insure scoring depth required. Work shall then be carefully troweled to a smooth, even finish, with edges rounded to a radius of 1/2", scoring markings made to required depth following which it shall be given a fine hair broom finish, applied transversely and remarked when required to insure a neat, uniform joint. Troweling may be done with a long handled trowel of "Fresno."
2. Contraction joints or block joints shall not exceed intervals of six feet. Joints shall be made at regular intervals along line of work. On straight work, joints shall be parallel with and at right angles to line of work; at curves the joints shall, in general, be along lines concentric with and radial to proportion of work in which they are placed. Markings shall be made with jointer tools that will round edges of scoring lines to a radius of 1/8", with depth not less than 1-1/4". The finished joint opening, exclusive of radii, shall not be wider than 1/8". The Contractor will be required to have a sufficient number of jointer tools on job to accomplish above specified requirements.
3. After edges and joints have been tooled, broom finish will be applied. Texture shall run uninterrupted from edge to edge. See drawings for extent of different broom finishes.
4. Side forms shall remain in place after completion of walk until concrete is sufficiently set, but must be removed before work will be accepted.

D. Gutter

1. After concrete has been thoroughly tamped in such manner and to such extent as to force larger aggregates into body thereof and bringing to top sufficient free mortar for finishing, surface shall be worked to a true and even grade by means of a float, troweled with a long handled trowel or Fresno and then longitudinally broom finished, following which the flow line of gutter shall be troweled smooth for a width of approximately 3" and outer edge rounded to radius of 1/2".
2. Side forms shall remain in place until concrete is sufficiently set, after completion of gutter, but must be removed before work will be accepted.
3. Valley gutter or cross gutter section shall have wire reinforcing mesh 6" x 6" No. 6 gauge and shall be used in both slab of gutter and in slab of fillets. Construction joints and 1/2" premolded expansion joints and other details of construction shall be as indicated on plans and detail drawings. Finished surface shall conform to required roadway section as to both line and grade. Gutter sections will not be opened to traffic until specimen beams have attained a flexural strength of not less than 500 PSI (AASHTO T97). When such tests are not conducted, the gutter shall not be opened to traffic until 14 days after concrete has

been placed. In event that high-early cement is used, flexural requirements will remain same as previously stated; however, in lieu of a flexural test and after a minimum of seven days curing has taken place, Architect will determine when sections may be opened to traffic.

E. Pavement

1. All subgrade preparation required for this item shall be done in accordance with applicable provisions of Division Section 31, Earthwork, with exception that minimum density requirements will be 90% of maximum density as determined by ASTM D1557 in all cases instead of 95% of maximum in the top 6" or 12" of compacted fill.
2. Wire reinforcing mesh shall be included and shall be 6" x 6" W1.4 x W1.4 fabric. Additional steel, if required, will be included as shown on the plans and shall be included as part of the item.
3. Thickness of concrete shall be 5" nominal and construction joints shall be required at 18-foot intervals maximum. Concrete shall be screeded and finished with wood float or equivalent to a plane surface having no variation when measured with a 10-foot straightedge in excess of 1/4", unless a curvilinear surface is designated.

3.7 CURING

- A. Protect and cure finished concrete paving, complying with applicable requirements of Division 03 sections.
- B. Liquid-Membrane Curing
 1. After completion of finishing operations, concrete shall be sprayed with concrete curing compound. The surface of concrete shall be kept thoroughly damp between completion of finishing operations and application of curing compound.
 2. Curing compound shall be applied under pressure, by means of a spray nozzle, in such a manner and quantity as to entirely cover all exposed surfaces of concrete with a uniform film. Preparation so used shall be Type 3, colorless.

3.8 REPAIRS AND PROTECTION

- A. Repair or replace broken or defective concrete as directed by the Architect.
- B. Sidewalk that is to be replaced shall be neatly sawcut. Minimum size slab that is removed and replaced to be 5 ft. long and for full width of walk. Curb and gutter shall be sawcut on a neat line at right angles to face of curb to at least 2/3 of full section of curb and/or gutter on either side of defective or damaged portion.
- C. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after the placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

3.9 BACKFILLING AND CLEANUP

- A. Backfilling to finished surface of newly constructed improvement must be completed before acceptance of work.
- B. Upon completion of the work, all earth or burlap covering shall be removed, the surface of the concrete thoroughly cleaned, and site left in a neat and orderly condition, including disposal of excess materials and earth.
- C. Concrete shall be free of stains, discoloration and other foreign material.

END OF SECTION