

Project Specifications
8/12/19

RIVERSTONE APARTMENTS

SAN MARCOS, TX

Architect of Record:

Kentucky Architecture Studio, LLC
2330 Frankfort Avenue
Louisville, KY 40206

Design Architect:

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1469 South Fourth
Louisville, KY 40208

Owner:

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Louisville, KY 40208

Contractor:

Xpert Design and Construction, LLC
1469 South Fourth
Louisville, KY 40208

Civil Engineers:

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Structural & MEP:

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Franklin, TN 30764

GENERAL INDEX TO SPECIFICATIONS

FOR

RIVERSTONE APARTMENTS

San Marcos, TX

August 12, 2019

PROJECT MANUAL; TECHNICAL SPECIFICATIONS

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DOCUMENT 00 01 15 - LIST OF DRAWING SHEETS

1.1 LIST OF DRAWINGS

- A. Drawings: Drawings consist of the Contract Drawings and other drawings listed on the Table of Contents page of the separately bound drawing set titled **COVER SHEET**, dated **08/12/2019**, as modified by subsequent Addenda and Contract modifications.

END OF DOCUMENT 00 01 15

SECTION 00 31 32 – GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 SUBSURFACE INVESTIGATION

- A. Subsurface Investigation: Soil investigation and Foundation Report was prepared for this site by Rone Engineering on June, 2019.
- B. The report is included in the specifications for your reference.

END OF SECTION 00 31 32

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 PROJECT INFORMATION

- A. Project Identification: Riverstone apartments.
 - 1. Project Location: San Marcos, TX
- B. Owner: Riverstone L.P., 1469 South 4th Street, Louisville, KY 40208.
- C. Architect: Studio A, LLC., 2330 Frankfort Ave., Louisville, KY 40204
- D. Architect's Consultants: Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
 - 1. MEPS Engineer: Genesis Engineering Group, LLC, 224 3rd Avenue North, Franklin, TN 37064.
 - 2. Civil Engineer: Costello Engineering & Surveying Inc. 1016 La Posada Dr. Suite 228, Austin, TX 78752
- E. Contractor: Xpert Design and Construction LLC. 1469 S. 4th St., Louisville, KY 40208
- F. The Work consists of 336 family apartments in (12) three story residential apartment buildings, and a clubhouse, Garage, & mail kiosk. All buildings will be wood framed, with an exterior finish of fiber cement lap siding and Texas Stone.

1.2 WORK RESTRICTIONS

- A. Contractor's Use of Premises: During construction, Contractor will have full use of site indicated. Contractor's use of premises is limited only by Owner's right to perform work or employ other contractors on portions of Project.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 6:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated.
- C. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.
- D. Refer to civil drawings for environmental requirements and restrictions during construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 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 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 14 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. 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.
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: Use Contractor's letterhead or standard proposal request form.

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 G710.
- B. Owner reserves the right to solicit bids from other sub contractors for change order work.

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.

1.3 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.
 - 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 at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Submit draft of AIA Document G703 Continuation Sheets.
 - 3. 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.
 - 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 - 5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
 - 6. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

7. 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.

1.4 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 Times: The period covered by each Application for Payment is one month.
- D. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets.
- E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect. 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 liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- G. 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. Products list.
 5. Schedule of unit prices.
 6. Submittals Schedule (preliminary, if not final).
 7. Copies of building permits.
 8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 9. Certificates of insurance and insurance policies.
 10. Performance and payment bonds.
- H. 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.
- I. 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 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 PROJECT MANAGEMENT AND COORDINATION

- A. Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work.
- B. Requests for Information (RFIs): On discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI.
- C. Schedule and conduct progress meetings at Project site at monthly intervals. Notify Owner and Architect of meeting dates and times. Require attendance of each subcontractor or other entity concerned with current progress or involved in planning, coordination, or performance of future activities.
- D. Applications for payment shall be made using HUD Form 92448, *Contractors Requisition*.
- E. Request for changes shall be made using HUD Form 92437, *Request for Construction Changes*.

1.2 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Upon request, electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections.
 - 1. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2.2 ACTION SUBMITTALS

- A. If submitting paper copies, submit **three** copies of each submittal unless otherwise indicated. Architect will return **two** copies.
- B. Product Data: Mark each copy to show applicable products and options. Include the following:
 - 1. Manufacturer's written recommendations, product specifications, and installation instructions.
 - 2. Wiring diagrams showing factory-installed wiring.
 - 3. Printed performance curves and operational range diagrams.
 - 4. Testing by recognized testing agency.
 - 5. Compliance with specified standards and requirements.
- 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. Submit on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches. Include the following:

1. Dimensions and identification of products.
2. Fabrication and installation drawings and roughing-in and setting diagrams.
3. Wiring diagrams showing field-installed wiring.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.

- D. Samples: Submit Samples for review of kind, color, pattern, and texture and for a comparison of these characteristics between submittal and actual component as delivered and installed. Include name of manufacturer and product name on label.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. HUD Form 5372, *Construction Progress Schedule*, shall be used for this project.

PART 3 - EXECUTION

3.1 SUBMITTAL 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. Architect will review each action submittal, make marks to indicate corrections or modifications required, will stamp each submittal with an action stamp, and will mark stamp appropriately to indicate action.
- 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. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 30 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. Administrative and supervisory personnel.
 - 2. Project meetings.
 - 3. Requests for Interpretation (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 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 2. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation 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. 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.
- C. 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 salvaged materials that are designated as Owner's property.

1.5 SUBMITTALS

- A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1.6 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 five days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect and Construction Manager, but no later than 21 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; Construction Manager 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.
 - 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.
 - 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: Construction Manager will record and distribute meeting minutes.
- C. Progress Meetings: Conduct progress meetings at monthly intervals. Coordinate dates of meetings with preparation of payment requests.
 - 1. Attendees: In addition to representatives of Owner Architect and Construction Manager, 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.

1.7 REQUESTS FOR INTERPRETATION (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 Contractor. RFIs submitted by entities other than 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. 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.
- D. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working 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.
- E. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

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 "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
 - 4. Division 01 Section "Closeout Procedures" for submitting warranties.
 - 5. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 6. Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
 - 7. 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 Floor plans of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals. Any other use of the electronic documents is prohibited.
- 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.

- C. Submittals Schedule: Comply with requirements in Division 01 Section "Project Management And Coordination" 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 15 calendar 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 15 days for review of each resubmittal.
 - 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 4x4 inches on a label or beside title block for the Architect's review stamp. Provide additional space to record Contractor's review and approval marking.
 - 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. Number and title of appropriate Specification Section.
 - i. Drawing number and detail references, as appropriate.
 - j. Location(s) where product is to be installed, as appropriate.
 - k. Other necessary identification.
 - F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
 - G. 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.
 - H. 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.
 - I. Use for Construction: Use only final submittals with mark indicating "No exception taken", or "Furnish as Corrected" notation from Architect's.
- 1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES
- A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
 - 1. Use of files are restricted to the Contractor's preparation of shop drawings for this project only.
 - 2. Details/plans shall be verified and modified to represent "as-built" conditions.

3. CAD system format will be provided in AutoCAD 2007 .DWF format unless other arrangements are made.

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. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operation and maintenance manuals.
 - k. Compliance with specified referenced standards.
 - l. Testing by recognized testing agency.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
 4. Submit Product Data before or concurrent with Samples.
 5. Number of Copies: Architect will retain three copies of product data.
- 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.
 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. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 - m. Relationship to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.
 - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 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 but no larger than 30 by 40 inches

3. Number of Copies: Submit a minimum of three opaque copies of each submittal, unless copies are required for operation and maintenance manuals. Submit a minimum of five copies where copies are required for operation and maintenance manuals. Architect/Engineer will retain three copies; remainder will be returned.
 4. Digital option: Contractor may submit digital copies in lieu of "hard" copies as long as copies for the operation and maintenance manuals are generated from the approved submittals.
- 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. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 4. 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 two full set(s) 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.
 5. 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 a minimum of three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
- E. Product Schedule or List: In individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product.
 2. Number and name of room or space.
 3. Location within room or space.
 4. Number of Copies: Submit a minimum of three copies of product schedule or list, unless otherwise indicated. Architect will return a minimum of two copies.
 - a. Mark up and retain one returned copy as a Project Record Document.
- F. Submittals Schedule: Comply with requirements specified in Division 01 Section " Project Management and Coordination."

- 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.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
 - 4. Number of Copies: Submit one electronic copy of subcontractor list, unless otherwise indicated.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit one copy of each submittal, unless otherwise indicated. Architect will not return copies.
 - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. 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.
- D. 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.
- E. 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.
- F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- G. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- J. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- K. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- L. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- M. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- N. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- O. 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."
- P. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- Q. 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.
- R. 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.
- S. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.
 - 1. Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

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. No exception Taken
 - 2. Furnish as Corrected
 - 3. Revise and Resubmit
 - 4. Rejected
- 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 SECTION REQUIREMENTS

- A. 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.
- B. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Architect for a decision.
- C. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum. The actual installation may exceed the minimum within reasonable limits. Indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision.
- D. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- E. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. 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. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- F. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, notices, receipts for fee payments, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
- G. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

- H. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated; and where required by authorities having jurisdiction, that is acceptable to authorities.
- I. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- J. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor of irregularities or deficiencies in the Work observed during performance of its services.
 - 2. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
 - 3. Do not perform any duties of Contractor.
- K. Associated Services: Cooperate with testing agencies and provide reasonable auxiliary services as requested. 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. Security and protection for samples and for testing and inspecting equipment.
- L. 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.
- M. Special Tests and Inspections: Engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction, as indicated in Statement of Special Inspections on sheet S0.02 of the construction drawings.

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.
- B. 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 42 00 - REFERENCES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. Abbreviations and Acronyms: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AHAM	Association of Home Appliance Manufacturers
AHRI	Air-Conditioning, Heating, and Refrigeration Institute, The
AI	Asphalt Institute
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standard Committee, Incorporated

AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.
APA	Architectural Precast Association
APA	APA - The Engineered Wood Association
API	American Petroleum Institute
ARI	Air-Conditioning & Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (American Society of Mechanical Engineers International)
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	Association of the Wall and Ceiling Industry
AWCMA	American Window Covering Manufacturers Association (Now WCMA)
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association)
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BICSI	BICSI, Inc.
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
BISSC	Baking Industry Sanitation Standards Committee

CCC	Carpet Cushion Council
CDA	Copper Development Association
CEA	Canadian Electricity Association
CEA	Consumer Electronics Association
CFFA	Chemical Fabrics & Film Association, Inc.
CGA	Compressed Gas Association
CIMA	Cellulose Insulation Manufacturers Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CPA	Composite Panel Association
CPPA	Corrugated Polyethylene Pipe Association
CRI	Carpet and Rug Institute (The)
CRRC	Cool Roof Rating Council
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CSA	CSA International (Formerly: IAS - International Approval Services)
CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association

	(Electrostatic Discharge Association)
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA)
FM Approvals	FM Approvals LLC
FM Global	FM Global (Formerly: FMG - FM Global)
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
FSA	Fluid Sealing Association
FSC	Forest Stewardship Council
GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Part of GSI)
GS	Green Seal
GSI	Geosynthetic Institute
HI	Hydronics Institute
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI)
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
IAPSC	International Association of Professional Security Consultants
ICBO	International Conference of Building Officials
ICEA	Insulated Cable Engineers Association, Inc.
ICPA	International Cast Polymer Association
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IEST	Institute of Environmental Sciences and Technology
IGMA	Insulating Glass Manufacturers Alliance

ILI	Indiana Limestone Institute of America, Inc.
ISA	Instrumentation, Systems, and Automation Society, The
ISO	International Organization for Standardization Available from ANSI
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek Testing Service NA (Now ETL SEMCO)
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LGSEA	Light Gauge Steel Engineers Association
LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association
MCA	Metal Construction Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association
NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCMA	National Concrete Masonry Association
NCTA	National Cable & Telecommunications Association

NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)
NOMMA	National Ornamental & Miscellaneous Metals Association
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
PCI	Precast/Prestressed Concrete Institute
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute
RIS	Redwood Inspection Service
SAE	SAE International
SCAQMD	South Coast Air Quality Management District
SCTE	Society of Cable Telecommunications Engineers

SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SIA	Security Industry Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
TCNA	Tile Council of North America, Inc.
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TMS	The Masonry Society
TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association
USGBC	U.S. Green Building Council

USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)
WIC	Woodwork Institute of California (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association
WSRCA	Western States Roofing Contractors Association
WWPA	Western Wood Products Association

- C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

IAPMO	International Association of Plumbing and Mechanical Officials
IBC	International Building Code
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.
IAPMO	International Association of Plumbing and Mechanical Officials
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.
IECC	International Energy Conservation Code

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 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, and security and protection facilities.
- B. Related Sections include the following:
 - 1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
 - 2. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 3. Division 01 Section "Execution" for progress cleaning requirements.
 - 4. Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
 - 5. Division 31 Section "Termite Control" for pest control.

1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, Engineer, testing agencies, and authorities having jurisdiction.
- B. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services for construction operations.
- C. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services for construction operations.

1.5 SUBMITTALS

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

1.6 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.

1.7 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. Chain-Link Fencing: Minimum 2-inch 0.148-inch-ck, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch line posts and 2-7/8-inch corner and pull posts, with 1-5/8-inch top rails.
- B. Portable Chain-Link Fencing: At contractor's option or where required for portable fencing for easy reconfiguration provide minimum 2-inch 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch line posts and 2-7/8-inch corner and pull posts, with 1-5/8-inch top and bottom rails. Provide concrete bases for supporting posts.
- C. Lumber and Plywood: Comply with requirements in Division 06 Section "Rough Carpentry"
- D. Paint: Comply with requirements in Division 09 painting Sections.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent 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.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

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 by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Use of Owner's existing 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 and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service underground unless otherwise indicated.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - 2. Install lighting for Project identification sign.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
 - 1. Provide superintendent with cellular telephone or portable two-way radio.
 - 2. At a central location, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Engineers' offices.
 - f. Owner's office.

g. Principal subcontractors' field and home offices.

- I. 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 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. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31 Section "Site Clearing."
3. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

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

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
2. Remove snow and ice to minimize accumulations.

F. 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 temporary, directional signs for construction personnel and visitors.
2. Maintain and touchup signs so they are legible at all times.
3. Provide project identification signs with all required entities logo and information for HUD and Equal Housing per MAP Guide

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.

1. Comply with work restrictions specified in Division 01 Section "Summary."

- B. Temporary Erosion and Sedimentation Control: Comply with requirements specified on Site Drawings."
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. 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. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- E. Site Enclosure Fence: When excavation begins, 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: to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.
- F. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 - 1. Prohibit smoking in completed areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
- B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced.
 - 1. Show compliance with requirements for comparable product requests.
 - 2. Architect will review the proposed product and notify Contractor of its acceptance or rejection.
- C. Basis-of-Design Product Specification Submittal: Show compliance with requirements.
- D. Compatibility of Options: If Contractor is given option of selecting between two or more products, select product compatible with products previously selected.
- E. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Deliver products to Project site in manufacturer's original sealed container or packaging, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 3. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 4. Store materials in a manner that will not endanger Project structure.
 - 5. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
- F. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. Provide products that comply with the Contract Documents, are undamaged, and, unless otherwise indicated, are new at the time of installation.
 - 1. Provide products complete with accessories, trim, finish, and other devices and components needed for a complete installation and the intended use and effect.
 - 2. Where products are accompanied by the term "as selected," Architect will make selection.
 - 3. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Where the following headings are used to list products or manufacturers, the Contractor's options for product selection are as follows:
 - 1. Products:

- a. Where requirements include "one of the following," provide one of the products listed that complies with requirements.
 - b. Where requirements do not include "one of the following," provide one of the products listed that complies with requirements or a comparable product.
 - 2. Manufacturers:
 - a. Where requirements include "one of the following," provide a product that complies with requirements by one of the listed manufacturers.
 - b. Where requirements do not include "one of the following," provide a product that complies with requirements by one of the listed manufacturers or another manufacturer.
 - 3. Basis-of-Design Product: Provide the product named, or indicated on the Drawings, or a comparable product by one of the listed manufacturers.
- C. Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
- D. Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Architect will consider Contractor's request for comparable product when the following conditions are satisfied:
- 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications.
 - 3. List of similar installations for completed projects, if requested.
 - 4. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 EXECUTION REQUIREMENTS

- A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- B. Cutting and Patching:
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching.
 - 2. 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.
 - 3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.2 CLOSEOUT SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.
- C. Operation and Maintenance Data: Submit two copies of manual.
- D. PDF Electronic File: Assemble manual into a composite electronically indexed file. Submit on digital media.
- E. Record Drawings: Submit one set of marked-up record prints.
- F. Record Product Data: Submit two paper copies or annotated PDF electronic files and directories of each submittal.

1.3 SUBSTANTIAL COMPLETION PROCEDURES

- A. 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.
- B. Submittals Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:
 - 1. Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other sections, including project record documents, operation and maintenance manuals, property surveys, similar final record information, warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

3. Submit maintenance material submittals specified in other sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect.
 4. Submit test/adjust/balance records.
 5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Advise Owner of changeover in heat and other utilities.
 6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 7. Remove temporary facilities and controls.
 8. Complete final cleaning requirements, including touchup painting.
 9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will proceed with inspection or advise Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.

1.4 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting inspection for determining final completion, complete the following:
1. Submit a final Application for Payment.
 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. Certified copy of the list shall state that each item has been completed or otherwise resolved.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
- B. 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 final Certificate for Payment after inspection or will advise Contractor of items 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.

PART 2 - PRODUCTS

2.1 MATERIALS

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

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

2.2 OPERATION AND MAINTENANCE DOCUMENTATION

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.
- B. Organization: Unless otherwise indicated, organize manual into separate sections for each system and subsystem, and separate sections for each piece of equipment not part of a system.
- C. Organize data into three-ring binders with identification on front and spine of each binder, and envelopes for folded drawings. Include the following:
 1. Manufacturer's operation and maintenance documentation.
 2. Maintenance and service schedules.
 3. Maintenance service contracts. Include name and telephone number of service agent.
 4. Emergency instructions.
 5. Spare parts list and local sources of maintenance materials.
 6. Wiring diagrams.
 7. Copies of warranties. Include procedures to follow and required notifications for warranty claims

2.3 RECORD DRAWINGS

- A. Record Prints: Maintain a set of prints of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued. Mark to show actual installation where installation varies from that shown originally. Accurately record information in an acceptable drawing technique.
 1. Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Existing Conditions: 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.
- B. Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance.
 1. Verify compatibility with and suitability of substrates.
 2. Examine roughing-in for mechanical and electrical systems.
 3. Examine walls, floors, and roofs for suitable conditions.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

- D. Take field measurements to fit the Work properly. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication.
- E. Verify space requirements and dimensions of items shown diagrammatically on Drawings.

3.2 CONSTRUCTION LAYOUT AND FIELD ENGINEERING

- A. Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks.
- B. Engage a land surveyor to lay out the Work using accepted surveying practices.
- C. Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project.
 - 1. At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.3 INSTALLATION

- A. 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. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations.
- C. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- D. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed.
- E. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
- F. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- G. Use products, cleaners, and installation materials that are not considered hazardous.

3.4 CLEANING

- A. Clean Project site and work areas daily, including common areas. Dispose of materials lawfully.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - 3. Remove debris from concealed spaces before enclosing the space.
- B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion:

1. Clean Project site, yard, and grounds, in areas disturbed by construction activities. Sweep paved areas; remove stains, spills, and foreign deposits. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
2. Sweep paved areas broom clean. Remove spills, stains, and other foreign deposits.
3. Remove labels that are not permanent.
4. Clean transparent materials, including mirrors. Remove excess glazing compounds.
5. Clean exposed finishes to a dust-free condition, free of stains, films, and foreign substances. Sweep concrete floors broom clean.
6. Vacuum carpeted surfaces and wax resilient flooring.
7. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and foreign substances. Clean plumbing fixtures. Clean light fixtures, lamps, globes, and reflectors.
8. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

3.5 OPERATION AND MAINTENANCE MANUAL PREPARATION

- A. 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.
- B. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 1. Prepare supplementary text if manufacturers' standard printed data are unavailable and where the information is necessary for proper operation and maintenance of equipment or systems.
- C. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams.

3.6 DEMONSTRATION AND TRAINING

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Include a detailed review of the following:
 1. Include instruction for basis of system design and operational requirements, review of documentation, emergency procedures, operations, adjustments, troubleshooting, maintenance, and repairs.

END OF SECTION 01 70 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 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.
- B. 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. Operating elements include the following:
 - 1. Primary operational systems and equipment.
 - 2. Fire-suppression systems.
 - 3. Mechanical systems piping and ducts.
 - 4. Control systems.
 - 5. Communication systems.
 - 6. Conveying systems.
 - 7. Electrical wiring systems.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:
 - 1. Water, moisture, or vapor barriers.
 - 2. Membranes and flashings.
 - 3. Exterior curtain-wall construction.
 - 4. Equipment supports.
 - 5. Piping, ductwork, vessels, and equipment.
- D. 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.

1.5 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

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

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.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

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.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch to restore surfaces to their original condition.

- B. 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.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
- C. 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.
1. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 2. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 3. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01 73 29

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. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. 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 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

- A. Initial Submittal: Submit 2 draft copies of each manual at least 10 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return one copy of draft and mark whether general scope and content of manual are acceptable.
- B. Final Submittal: Submit two copies of each manual in final form at least 10 days before final inspection. Architect/Engineer will return copy with comments within 10 days after final inspection.
 - 1. Correct or modify each manual to comply with Architect's comments. Submit 2 copies of each corrected manual within 15 days of receipt of Architect/Engineer's comments.
 - 2. Provide a digital copy of the Operation and Maintenance Manual on CD or other approved method.

1.5 COORDINATION

- A. Where operation and maintenance documentation includes 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 documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 - 1. Name and address of Project.
 - 2. Name and address of Owner.
 - 3. Date of submittal.
 - 4. Name, address, and telephone number of Contractor.
 - 5. Name and address of Architect.
 - 6. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
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 paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. 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. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.

5. Special operating instructions and procedures.

2.4 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. Performance and design criteria if Contractor is delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
 1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 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. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. 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.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. 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.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard printed maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties 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. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

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. 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 video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and 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. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit one copy within seven (7) days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
 - 3. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals and in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.

- d. Operating instructions for conditions outside of normal operating limits.
- e. Sequences for electric or electronic systems.
- f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

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.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Schedule training with Owner, through Architect with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- E. Cleanup: Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
 - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
 - 2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting .

- E. Systems, sub-systems and equipment that require demonstration and training are as follows::
 - 1. HVAC Roof top units
 - 2. Water Heater system
 - 3. Fire sprinkler System
 - 4. Lighting System; includes emergency lighting, occupancy sensors, multiple switching dimming, exit lighting, exterior lighting, lightning protection, and maintenance.
 - 5. Elevator Equipment

END OF SECTION 01 79 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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 specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings and grade beams.
 - 2. Slabs-on-grade.
 - 3. Concrete foundation walls.
- B. Related Sections include the following:
 - 1. Section 033650 Post-Tensioned Concrete

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Qualification Data: For Installer, manufacturer, and testing agency.
- E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

- F. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- G. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Waterstops.
 - 6. Curing compounds.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor retarders.
 - 11. Semirigid joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.
- H. Minutes of pre-installation conference.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete"
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures. Also see requirements of Special Inspection in structural drawings.
- G. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments and color treatment, and standard of workmanship.
 - 1. Build panel approximately 50 sq. ft. for slab-on-grade and formed surface in the location indicated or, if not indicated, as directed by Architect.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion, pending on approval from the architect and engineer.
- H. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

- A. Admixture: ASTM C 260.

2.2 Chemical Admixtures FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.

2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, , minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that will leave no corrodible metal closer than to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than in diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class C or F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

- A. Air-Entraining: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
- B. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ChemMasters.
 - b. Davis Colors.
 - c. Dayton Superior Corporation.
 - d. Hoover Color Corporation.
 - e. Lambert Corporation.
 - f. QC Construction Products.
 - g. Rockwood Pigments NA, Inc.
 - h. Scofield, L. M. Company.
 - i. Solomon Colors, Inc.
 - 2. Color: Contractor to coordinate with architect and owner.

2.7 FIBER REINFORCEMENT

- A. Not permitted unless approved by Engineer of Record. Contractor shall submit certification from the fiber reinforcement manufacturer showing the dosage (pound/CY) required to replace the wire mesh steel reinforcement specified on plan to meet temperature and shrinkage force.

Submittal shall show that proposed fiber reinforcement meets ACI 302, ACI 506, ASTM C1399, ASTM C94, ASTM C1609, ASTM C1116.

2.8 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Profile: Flat, dumbbell with center bulb.
 - 2. Dimensions: nontapered.
- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete.
- C. Unless noted otherwise on plans, waterstops shall be installed continuously along the base and top of concrete walls backing soil.

2.9 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class A. Minimum thickness as specified in Project Geotechnical Report. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.10 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately when dry.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating.
- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.11 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

- A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: well-graded, washed gravel or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than strength required on drawings at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 - 5. Silica Fume: 10 percent.
 - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings and grade beams: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: as indicated on drawings at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.50 or as indicated on drawings.
 3. Slump Limit: 8 inch for concrete with verified slump of before adding high-range water-reducing admixture or plasticizing admixture, plus or minus.
 4. Percentages in options in two subparagraphs below are default air contents required by ACI 301 for severe exposure.
 5. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for nominal maximum aggregate size.
- B. Foundation Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: as indicated on drawings at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: as indicated on drawings at 28 days.
 2. Minimum Water-Cementitious Materials Content: 0.50, except for slab on grade at indoor pool shall have maximum Water-Cementitious ratio of 0.40.
 3. Slump Limit: 6 inch plus or minus.
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for nominal maximum aggregate size.
 5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

2.15 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, for smooth-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 1. Lap joints and seal with manufacturer's recommended tape.
 2. Shall be provided at all grade beams and slabs. Thickness to be per geotechnical report.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls to meet ACI 301. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than or more than below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.7 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed

waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces. Verify all finishes requirements for compatibility with treat shown in architectural finish schedules and drawings.
- B. Flatness and Levelness Tolerances: Comply with ACI 117 recommendations for placing of all concrete. The following values in accordance with ASTM E1155 shall be provided:
 1. Finish surfaces to the following tolerances, according to ASTM E 1155 , for each floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
- C. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of in 1 direction.
 1. Apply scratch finish to surfaces.

- D. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- E. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with lap over adjacent absorptive covers.
 - 2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - 3. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than in any dimension in solid concrete, but not less than in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent

- has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Repair defective areas, except random cracks and single holes or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 5. Repair random cracks and single holes or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Steel reinforcement placement.
 2. Headed bolts and studs.
 3. Verification of use of required design mixture.
 4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.

6. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 7. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 8. Compressive-Strength Tests: ASTM C 39/C 39M;
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days with one set held in reserve.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than.
 11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION 03 30 00

SECTION 03 31 30 – STRUCTURAL LIGHTWEIGHT CONCRETE

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product data and mix designs

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ACI 301, "Specification for Structural Concrete," and with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

2.2 MATERIALS

- A. Refer to civil and structural drawings and specifications.

2.3 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 211.2.
- B. Light-Weight Concrete:
 - 1. Minimum Compressive Strength: Unless noted otherwise, 2500 psi at 28 days.

PART 3 - EXECUTION

3.1 CONCRETING

- A. Pumped concrete shall follow recommendations of ESCSI sheet 4770.1 and ACI 304.2

END OF SECTION 03 31 30

SECTION 03 36 50 - POST-TENSIONED CONCRETE

PART 1 - GENERAL

Applicable provisions of "General Conditions", "Supplementary General Conditions" and "General Requirements", Division One, govern work under this Section.

1.1 DESCRIPTION

- A. Work Included: Labor, materials and equipment necessary to prepare the final design of, and to complete post-tensioning of post-tensioned concrete slabs and beams as shown on the drawings or herein specified.
- B. Related Work Specified Elsewhere:
 - 1. Cast-In-Place Concrete: Section 033000

1.2 QUALITY ASSURANCE

- A. Reference Standards (Current Editions):
 - 1. ACI 301: Specifications for Structural Concrete for Buildings
 - 2. ACI 318: Building Code Requirements for Reinforced Concrete
 - 3. PTI: Recommendations for Concrete Members Prestressed with Unbonded Tendons
 - 4. International Building Code (IBC) 2012 Edition
 - 5. Maintain one (1) copy of reference standards at the construction office, readily accessible for reference.
- B. Post Tensioning Fabricator Qualifications:
 - 1. Fabricator shall have an experience record of at least five years of successful fabrication of post-tensioning tendons for slabs and beams in buildings of similar or greater size and complexity.
 - 2. Fabricator shall show proof of professional liability insurance current coverage in the amount of at least \$1,000,000.00.
- C. Specialty Engineer: Post tensioning fabricator shall furnish the services of a Specialty Engineer who shall be a Structural Engineer registered in the state where the project resides. Specialty Engineer shall supervise the final design of post-tensioned work to fit dimensions, load requirements and conditions shown on the drawings. He shall also supervise the preparation of shop drawings for post-tensioning work.

1.3 SUBMITTALS

- A. Design Calculations: Submit complete design calculations for all post-tensioning work. If calculations are done on computer, submit computer printout together with sample manual calculations keyed to printout. Identify design assumptions, input data and output data to permit proper evaluation. Calculations shall be signed and sealed by the Specialty Engineer registered in the state where the project resides as an indication that he understands the intent of the Structural Engineer of Record, that he has used the specified criteria, and that he has accepted responsibility for the results. The criteria shown on the Contract Documents shall be considered the minimum acceptable. Any and all variations from the criteria in the Contract Documents shall be clearly identified in the submittal. Submittal shall also include friction loss calculation to verify the effective stressing force.
- B. Installation Drawings:
 - 1. Identify the specific project.
 - 2. Show full details of materials and accessories to be used and instructions for construction.
 - 3. Drawings shall be submitted with the signature and seal of the Specialty Engineer.
 - 4. Drawings shall not contain reproductions of the contract drawings.
 - 5. Each submitted drawing shall be complete. No changes or additions shall be made to drawings after submittal except those needed to comply with Contractor's checking or Engineer's review.
- C. Records: Records of all jacking forces and elongations.
- D. Submittals shall be made electronically in PDF or equivalent format. Engineer will return comments electronically through the architect of record. Contractor is responsible for distribution of all comments to impacted subcontractors.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials to the site in a timely manner, so that work on the project is uninterrupted.
- B. Storage: Store materials for ease of inspection and identification. Keep items off the ground, using blocking or other supports. Protect materials from deterioration.
- C. Handling: Handle steel items so as to prevent bending or distortion of material.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with Reference Standards.
- B. Prestressing Steel:
 - 1. Prestressing steel shall be seven-wire stress-relieved low relaxation strand for prestressed concrete, manufactured in accordance with ASTM A 416, free from corrosion and having a guaranteed minimum ultimate tensile strength of 270 ksi.

Nominal diameter	1/2"
Area	0.153 sq. in.
Modulus of Elasticity	29,000 ksi
Ultimate strength	41.3 kips
Max. temporary force	33.0 kips
Anchoring force	28.9 kips
Final effective force	Within 7% of 26.7 kips To be determined in friction loss calculations by Post tensioned supplier

2. Strand shall be coated with a rust preventive grease and enclosed in an extruded plastic slippage sheathing. Torn or damaged sheathing shall be patched before concrete pouring. Small tears or sheath-free sections of cable less than 6 inches in length need not be patched.

C. Anchorages:

1. Anchor casting with reusable grommet shall be used at all stressing ends where anchorage must be recessed in concrete in order to receive required concrete cover. If possible, dip grommets in form oil for easy removal.
2. Anchor casting with split grommet shall be used at construction joints where tendons will be stressed intermediately and at other locations where stressing and anchorages will receive concrete cover by a reinforced concrete pour, wall pour or closure pour.
3. Anchor casting with shop pre-seated wedges shall be used for all fixed-end anchorages.
4. Anchors shall be as manufactured by VSL Corporation, Miami, Florida 33166.

- D. Other Materials: Materials for reinforcing steel, accessories and cast-in-place concrete shall be as specified in Related Work Sections.

2.2 FABRICATION

- A. General: Comply with Reference Standards.
- B. Length: Tendons shall be fabricated with sufficient length beyond edge form to allow stressing. A minimum length of twelve inches at each stressing end is required.
- C. Anchorages: Tendons that are stressed from one end only shall have fixed-end anchorages attached to one end prior to shipment. Tendons that are stressed intermediately at a construction joint shall have an anchorage placed at a predetermined distance along the tendon prior to shipment.
- D. Identification: Tendons shall be clearly identified by color code as called for on the placing drawings for easy placement.
- E. Bond Prevention: Tendons shall be shop coated with coating compound to prevent bond, reduce friction and resist corrosion, and shall be encased in seamless slippage sheathing to further assure prevention of bond.
- F. Fabricator: Tendons shall be as fabricated by VSL Corporation, Miami, Florida 33166, or accepted substitute.

- G. Other Materials: Fabrication of reinforcing steel and accessories shall be as specified in Related Work Sections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with Reference Standards.
- B. Locations: Locate the centerlines of tendon bundles at edge forms as shown on the tendon layout drawings. Locate and mark anchorage centerlines. At stressing ends, drill 1" diameter holes in edge forms. At intermediate stressing joints, notched or split forms shall be provided to facilitate tendon placing.
- C. Anchorages: At stressing ends nail anchorages with grommets securely in place against edge forms using ring shank nails.
- D. Placement:
1. Lay bottom perimeter bars along edges of slab and intermediate stressing joints.
 2. Lay top perimeter bars along slab edges and intermediate stressing joints. Tie bottom and top perimeter bars to anchorages or tendons as shown.
 3. Placement of reinforcing steel, accessories and cast-in-place concrete shall be as specified in Related Work Sections.
- E. Support: Chair up support bars according to tendon profiles. Place tendons with smooth horizontal curves at the anchorages as shown. Place one chair at each intersection of a bundle with a bar and tie chair, bar and bundle together. Slab tendons crossing over a beam may be tied directly to the top longitudinal bars of the beam if proper c.g.s. of the slab tendons is maintained.
- F. Protection: At stressing ends wrap tendon-anchorage connections with heavy duty tape to prevent cement flow into anchorages. Concrete shall be placed in such a manner as not to disturb tendon profiles. Workmen shall not be allowed to walk on tendon or support bars. Any tendons displaced during concrete placement must be restored to their original profile before concrete sets.
- G. Superintendence: Stressing operation shall be under the immediate control of a person experienced in this type of work who shall exercise and supervise all requirements of quality assurance required in the Specifications.
- H. Stressing:
1. All prestressing steel shall be stressed by means of hydraulic jacks, equipped with calibrated hydraulic pressure gages. A calibration chart shall accompany each jack. If inconsistencies between measured elongation and jack gage reading occur, the jack-gage-pump unit shall be recalibrated. An agreement of within 5% will be satisfactory.
 2. Stressing operation shall proceed in strict conformance with fabricator's recommendations.

- I. Cut-off: After stressing is completed, elongations verified and with prior written approval of the Architect and Engineer of Record obtained, tendons shall be burned off within one inch (1") from slab edge. Coat stressing hardware with corrosion preventive materials such as asphaltic paint.

3.2 FIELD QUALITY CONTROL

- A. Inspection: Tendon fabricator shall provide qualified representatives to inspect and recommend corrections in the post-tensioning work during construction, as follows:
 - 1. For each of the first two sections of slab being constructed, inspect in-place tendons prior to concrete placement, for proper positioning and restraint.
 - 2. For each of the first two sections of slab being constructed, observe tensioning of tendons for proper procedure in calibration of tensioning equipment, tensioning of tendons, measurements of elongation, anchorage of tendons and recording of data for submittal.
 - 3. Report results of inspections and recommended corrections to the Architect and Engineer of Record and the Contractor in writing within 24 hours after inspection.
- B. Notification: Notify the fabricator three working days in advance of each of the days on which inspections are to be made.
- C. Correction: Make corrections as recommended by fabricator.

END OF SECTION 03 36 50

SECTION 03 54 00 – GYPSUM UNDERLAYMENT

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Design mixes
 - 2. Primers and sealers
- B. Project Conditions:
 - 1. Before, during and after installation, building interior shall be enclosed and maintained at a temperature above 50 degrees F.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Gypsum Underlayment:
 - 1. Maxxon
 - 2. USG
 - 3. Gyp-Crete

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum compressive strength of 1800-2500 PSI.

EXECUTION

2.3 APPLICATION

- A. Prior to installation, clean and dry subfloor per manufacturer recommendation.
- B. Before applying gypsum underlayment, apply primer(s) as recommended by manufacturer.

END OF SECTION 03 54 00

SECTION 04 10 00 - MORTAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of "General Conditions", "Supplementary General Conditions" and "General Requirements", Division One, govern work under this Section.

1.2 DESCRIPTION

- B. Work Included: The furnishing of masonry mortar as specified herein.
- C. Related Work Specified Elsewhere:
 - 1. Cast-In-Place Concrete - Section 03 30 00.
 - 2. Concrete Unit Masonry - Section 04 22 00.

1.3 QUALITY ASSURANCE

- A. Qualifications of Manufacturers:
 - 1. Portland Cement shall be manufactured by a recognized American firm regularly engaged in the manufacture of the product.
 - 2. Admixture shall be a manufactured product for the purpose of providing a maximum reduction of mixing water, minimum bleeding and minimum water absorption, and shall be used in strict accordance with manufacturer's printed instructions.

1.4 SUBMITTALS

- A. Manufacturer's Data: Submit to architect for approval, a complete schedule of mortar materials proposed to be used, including manufacturer's and trade names of Portland cement and mortar admixture.
- B. Original Construction Documents shall not be duplicated for use as shop drawing submittals.

1.5 PRODUCT HANDLING

- A. Delivery & Storage:
 - 1. Packaged materials shall be delivered and stored in manufacturer's original, unopened containers until required for use. Packages showing evidence of water or other damage shall be rejected, removed from the premises, and replaced.
 - 2. Materials shall be stored in dry areas, clear of ground water and adequately protected against rain by the use of tarpaulins, etc.
 - 3. Sand shall be stored in such a manner as to prevent deterioration or intrusion of foreign material.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portland Cement Lime Mortar: Shall consist of Portland cement, hydrated lime or lime putty, and sand as specified herein.
 - 1. Masons cement may be used if prepared in accordance with manufacturer's instructions for obtaining mortar specified. (Submit color chart for selection by Architect).
- B. Portland Cement: ASTM C150-85, Type I.
- C. Aggregates:
 - 1. Fine Aggregates: ASTM C144-84, sand for masonry mortar.
 - 2. Coarse Aggregates: ASTM C404-76, (1981) for masonry grout.
- D. Hydrated Lime: ASTM C207, (1984) Type S.
- E. Quick Lime: For preparation of lime putty, ASTM C5-79, (1984).
- F. Water: Shall be potable.
- G. Admixture (Wetting Agent): Shall be manufactured by W.R. Grace and Company.

2.2 MIXES

- A. Mortar materials shall be mixed in proportions conforming to the requirements of ASTM C270, Type S, mortar having an average compressive strength at 28 days of 2500 PSI.
- B. Concrete fill for concrete masonry lintel units and other reinforced masonry shall be as specified in Section 03 30 00, Cast-In-Place Concrete, except that coarse aggregate shall be 3/8" to No. 4 nominal size.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Mixing: Proportion materials by volume or methods that will insure accurate proportions of all ingredients mixed by power driven mixer until entire batch is homogeneous and proper consistency. Adjust consistency to satisfaction of mason but add only as much water as is convenient in using mortar.
- B. Retempering: Use all mortar within two hours of initial mixing. Retempering will not be permitted.
- C. Waterproofing Admixture: Include waterproofing admixture in mortar mix for concrete masonry units at retaining walls, building stem walls, and all exposed conditions. Add admixture in compliance with manufacturer's recommendations. See Section 04 20 00 for acceptable manufacturers.

3.2 INSTALLATION

- A. Mortar: Mortar is installed under Section 04 22 00, Concrete Unit Masonry.

- B. Water Retention: Mortar mixed to initial flow of 100 to 115 percent with flow after suction of not less than 70 percent.

END OF SECTION 04 10 00

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. See Section 05 50 00 "Metal Fabrications" for furnishing steel **lintels** for unit masonry.
- B. Submittals:
 - 1. Material Certificates: For each type of product indicated. Include statements of material properties indicating compliance with requirements.

PART 2 - PRODUCTS

2.1 UNIT MASONRY

- A. Comply with ACI 530.1/ASCE 6/TMS 602.

2.2 MASONRY UNITS

- A. Concrete Masonry Units: ASTM C 90; Density Classification, **Normal Weight**.
 - 1. Integral Water Repellent:
 - 2. Products:
 - a. ACM Chemistries; RainBloc.
 - b. BASF Aktiengesellschaft; Rheopel Plus.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.
 - 3. Special shapes for lintels, corners, jambs, sash, control joints, and other special conditions.
 - 4. **Square-edged** units for outside corners unless otherwise indicated.
- B. Stone veneer:
 - 1. Texas chalk to be installed in coursed rubble pattern, as indicated on drawings.

2.3 MORTAR AND GROUT

- A. Mortar: ASTM C 270, proportion specification.
 - 1. Use **masonry cement** mortar.
 - 2. Do not use calcium chloride in mortar.
 - 3. For masonry below grade or in contact with earth, use **Type M**.
 - 4. For reinforced masonry, use **Type N**.
 - 5. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions, and for other applications where another type is not indicated, use Type N.
- B. Grout: ASTM C 476 with a slump of 8 to 11 inches.

2.4 REINFORCEMENT, TIES, AND ANCHORS

- A. Steel Reinforcing Bars: Refer to structural drawings and specifications for reinforcing steel in masonry walls.
- B. Joint Reinforcement: ASTM A 951.
 - 1. Coating: **Hot-dip galvanized at both interior and exterior walls**.
 - 2. For single-wythe masonry, provide either ladder design or truss design.

- C. Corrugated-Metal Veneer Anchors: 7/8 inch wide and made from 22 gauge steel sheet, galvanized after fabrication

2.5 EMBEDDED FLASHING MATERIALS

- A. Rubberized Asphalt Sheet Flashing: Pliable, adhesive rubberized-asphalt compound, bonded to a polyethylene film to produce an overall thickness of **0.040 inch**. Use only where flashing is fully concealed.
 - 1. Products:
 - a. Advanced Building Products Inc.; Peel-N-Seal.
 - b. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - c. Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
 - d. Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
 - e. Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
 - f. Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
 - g. Hohmann & Barnard, Inc.; Textroflash.
 - h. W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
 - i. Polyguard Products, Inc.; **Polyguard 400**.
 - j. Sandell Manufacturing Co., Inc.; Sando-Seal.
 - k. Williams Products, Inc.; Everlastic MF-40.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded strips complying with ASTM D 1056, Grade 2A1.
- B. Preformed Control-Joint Gaskets: Designed to fit standard sash block and to maintain lateral stability in masonry wall; made from styrene-butadiene rubber or PVC.
- C. Weep Holes: Cotton or polyester rope, **1/4 to 3/8 inch** in diameter, **24 inches** long.
- D. Cavity Drainage Material: Free-draining polymer mesh, full depth of cavity.
 - 1. Products:
 - a. Advanced Building Products Inc.; **Mortar Break**.
 - b. Archovations, Inc.; CavClear Masonry Mat.
 - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
 - d. Mortar Net USA, Ltd.; Mortar Net.
- E. Loose-Granular Perlite Insulation: ASTM C 549, Type II or IV.
- F. Molded-Polystyrene Insulation Units: ASTM C 578, Type I; specially shaped units designed for installing in cores of masonry units.
 - 1. Products:
 - a. Concrete Block Insulating Systems; Korfil.
 - b. Shelter Enterprises Inc.; Omni Core.
- G. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV or X.
- H. Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 2; aluminum-foil faced.
- I. Proprietary Acidic Masonry Cleaner: Product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units.
 - 1. Manufacturers:
 - a. Diedrich Technologies, Inc.

- b. EaCo Chem, Inc.
- c. ProSoCo, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cut masonry units with saw. Install with cut surfaces and, where possible, cut edges concealed.
- B. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.
- C. Stopping and Resuming Work: Rack back units; do not tooth.
- D. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- E. Tool exposed joints slightly concave when thumbprint hard unless otherwise indicated.
- F. Keep cavities clean of mortar droppings and other materials during construction.

3.2 LINTELS

- A. Install lintels where indicated.
- B. Minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.3 FLASHING AND WEEP HOLES

- A. Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.
- B. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing before covering with mortar.
 - 1. Extend flashing 4 inches into masonry at each end and turn up 2 inches to form a pan.
- C. Trim wicking material used in weep holes flush with outside face of wall after mortar has set.

3.4 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections required by authorities having jurisdiction.

3.5 CLEANING

- A. Clean masonry as work progresses. Remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly cured, clean exposed masonry.
 - 1. Wet wall surfaces with water before applying acidic cleaner, then remove cleaner promptly by rinsing thoroughly with clear water.
 - 2. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 04 20 00

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. See Section 05 50 00 "Metal Fabrications" for furnishing steel **lintels** for unit masonry.
- B. Submittals:
 - 1. Material Certificates: For each type of product indicated. Include statements of material properties indicating compliance with requirements.
 - 2. Samples for verification: For each type and color of the following:
 - a. Face Brick, in the form of five straps or more brick showing full range.
 - b. Weep holes/vents

PART 2 - PRODUCTS

2.1 UNIT MASONRY

- A. Comply with ACI 530.1/ASCE 6/TMS 602.

2.2 MASONRY UNITS

- A. Concrete Masonry Units: ASTM C 90; Density Classification, **Normal Weight**.
 - 1. Integral Water Repellent:
 - 2. Products:
 - a. ACM Chemistries; RainBloc.
 - b. BASF Aktiengesellschaft; Rheopel Plus.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.
 - 3. Special shapes for lintels, corners, jambs, sash, control joints, and other special conditions.
 - 4. **Square-edged** units for outside corners unless otherwise indicated.

2.3 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 FSB.
 - 1. Size (Modular): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
 - 2. Application: Use where brick is exposed, unless otherwise indicated.
 - 3. Manufacturer: To be selected by Owner.
 - 4. Color: To be selected by Owner.

2.4 MORTAR AND GROUT

- A. Mortar: ASTM C 270, proportion specification.
 - 1. Use **masonry cement** mortar.
 - 2. Do not use calcium chloride in mortar.
 - 3. For masonry below grade or in contact with earth, use **Type M**.
 - 4. For reinforced masonry, use **Type N**.
 - 5. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions, and for other applications where another type is not indicated, use Type N.
- B. Grout: ASTM C 476 with a slump of 8 to 11 inches.

2.5 REINFORCEMENT, TIES, AND ANCHORS

- A. Steel Reinforcing Bars: Refer to structural drawings and specifications for reinforcing steel in masonry walls.
- B. Joint Reinforcement: ASTM A 951.
 - 1. Coating: **Hot-dip galvanized at both interior and exterior walls**.
 - 2. For single-wythe masonry, provide either ladder design or truss design.
- C. Corrugated-Metal Veneer Anchors: 7/8 inch wide and made from 22 gauge steel sheet, galvanized after fabrication

2.6 EMBEDDED FLASHING MATERIALS

- A. Rubberized Asphalt Sheet Flashing: Pliable, adhesive rubberized-asphalt compound, bonded to a polyethylene film to produce an overall thickness of **0.040 inch**. Use only where flashing is fully concealed.
 - 1. Products:
 - a. Advanced Building Products Inc.; Peel-N-Seal.
 - b. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - c. Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
 - d. Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
 - e. Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
 - f. Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
 - g. Hohmann & Barnard, Inc.; Textroflash.
 - h. W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
 - i. Polyguard Products, Inc.; **Polyguard 400**.
 - j. Sandell Manufacturing Co., Inc.; Sando-Seal.
 - k. Williams Products, Inc.; Everlastic MF-40.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded strips complying with ASTM D 1056, Grade 2A1.
- B. Preformed Control-Joint Gaskets: Designed to fit standard sash block and to maintain lateral stability in masonry wall; made from styrene-butadiene rubber or PVC.
- C. Weep Holes: Cotton or polyester rope, **1/4 to 3/8 inch** in diameter, **24 inches** long.
- D. Cavity Drainage Material: Free-draining polymer mesh, full depth of cavity.

1. Products:
 - a. Advanced Building Products Inc.; **Mortar Break.**
 - b. Archovations, Inc.; CavClear Masonry Mat.
 - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
 - d. Mortar Net USA, Ltd.; Mortar Net.
- E. Loose-Granular Perlite Insulation: ASTM C 549, Type II or IV.
- F. Molded-Polystyrene Insulation Units: ASTM C 578, Type I; specially shaped units designed for installing in cores of masonry units.
 1. Products:
 - a. Concrete Block Insulating Systems; Korfil.
 - b. Shelter Enterprises Inc.; Omni Core.
- G. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV or X.
- H. Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 2; aluminum-foil faced.
- I. Proprietary Acidic Masonry Cleaner: Product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units.
 1. Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cut masonry units with saw. Install with cut surfaces and, where possible, cut edges concealed.
- B. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.
- C. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed brick in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Rack back units; do not tooth.
- E. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- F. Tool exposed joints slightly concave when thumbprint hard unless otherwise indicated.
- G. Keep cavities clean of mortar droppings and other materials during construction.

3.2 LINTELS

- A. Install lintels where indicated.
- B. Minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.3 FLASHING AND WEEP HOLES

- A. Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.
- B. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing before covering with mortar.
 - 1. Extend flashing 4 inches into masonry at each end and turn up 2 inches to form a pan.
- C. Trim wicking material used in weep holes flush with outside face of wall after mortar has set.

3.4 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections required by authorities having jurisdiction.

3.5 CLEANING

- A. Clean masonry as work progresses. Remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly cured, clean exposed masonry.
 - 1. Wet wall surfaces with water before applying acidic cleaner, then remove cleaner promptly by rinsing thoroughly with clear water.
 - 2. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 04 20 00

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. See Section 05 50 00 "Metal Fabrications" for furnishing steel **lintels** for unit masonry.
- B. Submittals:
 - 1. Material Certificates: For each type of product indicated. Include statements of material properties indicating compliance with requirements.

PART 2 - PRODUCTS

2.1 UNIT MASONRY

- A. Comply with ACI 530.1/ASCE 6/TMS 602.

2.2 MASONRY UNITS

- A. Concrete Masonry Units: ASTM C 90; Density Classification, **Normal Weight**.
 - 1. Integral Water Repellent:
 - 2. Products:
 - a. ACM Chemistries; RainBloc.
 - b. BASF Aktiengesellschaft; Rheopel Plus.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.
 - 3. Special shapes for lintels, corners, jambs, sash, control joints, and other special conditions.
 - 4. **Square-edged** units for outside corners unless otherwise indicated.
- B. Stone veneer:
 - 1. Texas chalk to be installed in coursed rubble pattern, as indicated on drawings.

2.3 MORTAR AND GROUT

- A. Mortar: ASTM C 270, proportion specification.
 - 1. Use **masonry cement** mortar.
 - 2. Do not use calcium chloride in mortar.
 - 3. For masonry below grade or in contact with earth, use **Type M**.
 - 4. For reinforced masonry, use **Type N**.
 - 5. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions, and for other applications where another type is not indicated, use Type N.
- B. Grout: ASTM C 476 with a slump of 8 to 11 inches.

2.4 REINFORCEMENT, TIES, AND ANCHORS

- A. Steel Reinforcing Bars: Refer to structural drawings and specifications for reinforcing steel in masonry walls.
- B. Joint Reinforcement: ASTM A 951.
 - 1. Coating: **Hot-dip galvanized at both interior and exterior walls**.
 - 2. For single-wythe masonry, provide either ladder design or truss design.

- C. Corrugated-Metal Veneer Anchors: 7/8 inch wide and made from 22 gauge steel sheet, galvanized after fabrication

2.5 EMBEDDED FLASHING MATERIALS

- A. Rubberized Asphalt Sheet Flashing: Pliable, adhesive rubberized-asphalt compound, bonded to a polyethylene film to produce an overall thickness of **0.040 inch**. Use only where flashing is fully concealed.
 - 1. Products:
 - a. Advanced Building Products Inc.; Peel-N-Seal.
 - b. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - c. Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
 - d. Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
 - e. Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
 - f. Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
 - g. Hohmann & Barnard, Inc.; Textroflash.
 - h. W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
 - i. Polyguard Products, Inc.; **Polyguard 400**.
 - j. Sandell Manufacturing Co., Inc.; Sando-Seal.
 - k. Williams Products, Inc.; Everlastic MF-40.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded strips complying with ASTM D 1056, Grade 2A1.
- B. Preformed Control-Joint Gaskets: Designed to fit standard sash block and to maintain lateral stability in masonry wall; made from styrene-butadiene rubber or PVC.
- C. Weep Holes: Cotton or polyester rope, **1/4 to 3/8 inch** in diameter, **24 inches** long.
- D. Cavity Drainage Material: Free-draining polymer mesh, full depth of cavity.
 - 1. Products:
 - a. Advanced Building Products Inc.; **Mortar Break**.
 - b. Archovations, Inc.; CavClear Masonry Mat.
 - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
 - d. Mortar Net USA, Ltd.; Mortar Net.
- E. Loose-Granular Perlite Insulation: ASTM C 549, Type II or IV.
- F. Molded-Polystyrene Insulation Units: ASTM C 578, Type I; specially shaped units designed for installing in cores of masonry units.
 - 1. Products:
 - a. Concrete Block Insulating Systems; Korfil.
 - b. Shelter Enterprises Inc.; Omni Core.
- G. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV or X.
- H. Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 2; aluminum-foil faced.
- I. Proprietary Acidic Masonry Cleaner: Product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units.
 - 1. Manufacturers:
 - a. Diedrich Technologies, Inc.

- b. EaCo Chem, Inc.
- c. ProSoCo, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cut masonry units with saw. Install with cut surfaces and, where possible, cut edges concealed.
- B. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.
- C. Stopping and Resuming Work: Rack back units; do not tooth.
- D. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- E. Tool exposed joints slightly concave when thumbprint hard unless otherwise indicated.
- F. Keep cavities clean of mortar droppings and other materials during construction.

3.2 LINTELS

- A. Install lintels where indicated.
- B. Minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.3 FLASHING AND WEEP HOLES

- A. Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.
- B. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing before covering with mortar.
 - 1. Extend flashing 4 inches into masonry at each end and turn up 2 inches to form a pan.
- C. Trim wicking material used in weep holes flush with outside face of wall after mortar has set.

3.4 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections required by authorities having jurisdiction.

3.5 CLEANING

- A. Clean masonry as work progresses. Remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly cured, clean exposed masonry.
 - 1. Wet wall surfaces with water before applying acidic cleaner, then remove cleaner promptly by rinsing thoroughly with clear water.
 - 2. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 04 20 00

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of "General Conditions", "Supplementary General Conditions" and "General Requirements", Division One, govern work under this section.

1.2 DESCRIPTION

- A. Work Included: Labor, materials and equipment to construct concrete unit masonry work as shown on the drawings or specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Cast-In-Place Concrete: Section 033000
 - 2. Caulking, Joint Fillers and Sealants: Division 07 Sections

1.3 QUALITY ASSURANCE

- A. Reference Standards: (Current Editions)
 - 1. ACI 530.1: Specifications for Masonry Structures.
 - 2. ACI Publications referenced herein.
 - 3. ASTM Standards referenced herein.
- B. Accessibility of Standards: Maintain one copy of ACI 530.1 at the construction office, readily accessible for reference.
- C. Masonry Strength: Net area compressive strength of masonry (f'm) shall be as shown on Structural Drawings.

1.4 SUBMITTALS

- A. General: Conform to ACI 530.1.
 - 1. One Specimen of each type of masonry unit proposed for use (stretcher units, control joint units, etc.).
 - 2. Results of tests of masonry units showing compliance with Specifications.
 - 3. Results of mortar tests showing compliance with Specifications.
 - 4. Producer's certificate showing that grout for the project conforms to Specifications.
 - 5. Cold weather construction procedures.
 - 6. Hot weather construction procedures.
 - 7. Manufacturer's literature for submittal items.
 - 8. Shop drawings showing details of steel reinforcement and masonry lintels.
 - a. Drawings shall not contain reproductions of contract drawings.
 - b. Each submitted drawing shall be complete. No changes or additions shall be made to drawings after submittal except those needed to comply with Contractor's checking, or Engineer's review.
 - 9. One sample at least 6 inches long of each type of non-masonry joint material proposed for use.

10. Compressive strength of masonry determined by the unit strength method from tests on proposed masonry units and mortar, showing compliance with the Specifications.
 11. One sample of masonry wall panels representative of quality, materials and color proposed for construction. Lay up sample at jobsite in location approved by Architect. Maintain sample in as-built condition until project is accepted by Owner. Minimum sample size 4'-0" long X 4'-0" high.
- B. Copies: Forward submittals in sufficient copies that the Architect may retain two copies of each submittal, or as directed in Division One.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with ACI 530.1.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with ACI 530.1.
- B. Concrete Masonry Units:
1. Units shall conform to ASTM C90, Type II, two cell, hollow, load bearing units of 8-inch by 16-inch nominal face size and bed dimension as shown on the drawings. Units shall be normal weight unless otherwise noted, and shall have no end flanges. Average compressive strength for the net area shall be as shown on Structural Drawings. CMU intended to have faces exposed to weather shall be manufactured with admixtures for water repellency in accordance with the requirements of Section 04 20 00.
 2. Units shall be free from substances that would cause staining or pop-outs and shall be of fine, even texture with straight, true edges.
 3. Obtain units from one manufacturer to insure even color and texture.
 4. Provide special units required by the drawings, including corner, pilaster, sash and jamb units.
- C. Mortar:
1. Mortar shall conform to ASTM C270, and shall contain no admixtures except as permitted under Section 04 10 00 and Section 04 20 00.
 2. Mortar shall conform to Type S. Color of mortar shall match color of masonry units.
- D. Lintels: Masonry lintels shall be precast concrete, U-type, of thickness to match supported wall. End bearings shall contain openings for installation of vertical bars and grout. As manufactured by Power Concrete Products, Co., Orlando, FL, or accepted substitute. Length shall provide for at least 8-inches of bearing on masonry at each end.
- E. Grout:
1. Grout shall conform to ASTM C476, and shall contain no admixtures.
 2. Grout shall be fine or coarse, as best suits the application.
 3. At placement, grout slump shall be between 8 inches and 11 inches.
- F. Reinforcement:
1. Reinforcing bars shall conform to ASTM A615, Grade 60.

2. Joint reinforcement shall be galvanized, single width truss type, fabricated with a single pair of deformed 9-gage side rods and continuous 9-gage cross rods spaced not more than 16 inches on center. Furnish complete with prefabricated corners and tees. Width shall be 2-inches narrower than wall. Where wall is used to back-up face brick, furnish with 3/16-inch diameter adjustable wall tie eye sections spaced at 24-inches on center, complete with rectangular pintles. Length as required to span insulation air space plus 3-inches into face brick. Dur-O-Wal, or accepted substitute.

G. Accessories:

1. Galvanized 24-gage dove-tailed anchor slots with anchors at 16-inches o.c. Heckmann Building Products, or accepted substitute. Dove-tailed anchors shall be designed to resist wind component and cladding pressures specified in structural drawings (for tornado event) and seismic forces in ASCE 7-05.
2. Miscellaneous anchors and attachment members required for anchorage of this work and work of other trades requiring attachment to masonry, which are not specifically provided under separate sections.
3. Control joint gaskets shall be factory extruded preformed polyvinyl chloride shear keys. Dur-O-Wal "Regular Rapid Poly-Joint", or accepted substitute.
4. Cleaning agent shall be a mild, non-caustic detergent solution. 801 Super Real Clean by Superior Mfg., Co., or accepted substitute.

PART 3 - EXECUTION

3.1 MASONRY, REINFORCEMENT, METAL ACCESSORIES AND GROUT

- A. General: Conform to ACI 530.1.
- B. Wetting Units: Do not wet masonry units before placing in wall.
- C. Bond: Construct masonry in running bond pattern with head joints in successive courses horizontally offset one-half unit length.
- D. Lintels: Install precast concrete lintels so that length of bearing at each end is at least 8-inches. Fill with pea-gravel concrete ($f'c=3000$ psi) if recommended by manufacturer. Before installing lintels, fill wall cells under bearings with grout.
- E. Reinforcing Bars: Lap bars 48 diameters at splices. Center vertical reinforcement in cells, unless otherwise noted.
- F. Joint Reinforcement: Place reinforcement in horizontal joints at 16 inches o.c. measured vertically. Lap reinforcement at least 8 inches at splices. Install prefabricated corners and tees at wall intersections.
- G. Bed and Head Joints: Joints shall be 3/8" thick. Cut off mortar flush with block face, and tool joints slightly concave. Rake out mortar in preparation for application of caulking or sealants where shown.
- H. Grout Vibration: Mechanical vibration shall be performed using a low velocity vibrator with a 3/4-inch head. Activate vibrator for one to two seconds in each grouted cell of hollow masonry. Do not over-vibrate.

- I. Wall Control Joints: Install where shown, but not to exceed horizontal spacing of 24'-0" o.c.
- J. Filled Cells: At vertical cells to be filled with grout, lay masonry units with full bed joints around cells.
- K. Build-in items furnished by Others for anchorage or support of their work.

3.2 REPAIR, POINTING AND CLEANING

- A. Repair: Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new matching units and install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.
- C. Cleaning: Clean exposed masonry by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings.

3.3 FIELD QUALITY CONTROL

- A. Inspections and Testing:
 - 1.
 - 2. The Owner will engage an independent engineering testing laboratory to conduct tests of masonry prisms and grout for compliance with Specification requirements.
 - 3. Coordinate and cooperate with testing laboratory to expedite this work.
 - 4. Results of inspections and tests shall be reported to the Architect on the same day as completed.
 - 5. Prism Testing:
 - a. Conform to ACI 530.1.
 - b. Prior to construction, perform two tests on samples of materials to be used in construction to determine masonry strengths at 7 days and at 28 days, and to verify adequacy of strength for the project.
 - c. During construction, perform tests on materials at site to verify that specified strengths are being provided. Tests may be made at 7 days and strengths determined by comparison with tests made prior to construction. Make two separate unscheduled tests during construction of each story of masonry.
 - 6. Grout Testing:
 - a. Test grout in conformance with ACI 530.1.

END OF SECTION 04 22 00

SECTION 05 12 00 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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. Structural steel.
 - 2. Grout.
- B. Related Sections include the following:
 - 1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 5 Section "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
 - 3. Division 9 painting Sections for surface preparation and priming requirements.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC's "Manual of Steel Construction, Allowable Stress Design," Part 4.
 - 2. Engineering Responsibility: Fabricator's responsibilities include using a structural engineer registered in the state of Tennessee to prepare structural analysis data for structural-steel connections.
- B. Construction: Type 2, simple framing.
- C. Steel exposed to weather or as indicated in drawings: Hot dipped galvanized.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 5. For structural-steel connections include structural analysis data signed and sealed by a professional engineer registered in the state of Tennessee.
- C. Welding certificates.
- D. Qualification Data: For Installer, fabricator, professional engineer, and testing agency.
- E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
1. Structural steel including chemical and physical properties.
 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 3. Direct-tension indicators.
 4. Tension-control, high-strength bolt-nut-washer assemblies.
 5. Shear stud connectors.
 6. Shop primers.
 7. Nonsrink grout.
- F. Source quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Sbd.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel."
- D. Comply with applicable provisions of the following specifications and documents:
1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 3. AISC's "Specification for the Design of Steel Hollow Structural Sections."
 4. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
 5. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.

2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Angles: ASTM A 572/A 572M, Grade .
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Welding Electrodes: E70XX unless noted otherwise and shall comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: , Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts; and hardened carbon-steel washers.
 1. Finish: Plain.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy hex head steel structural bolts with splined ends; heavy hex carbon-steel nuts; and hardened carbon-steel washers.
 1. Finish: Plain.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- D. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
 1. Nuts: heavy hex carbon steel.
 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 3. Washers: hardened carbon steel.
 4. Finish: Plain.

2.3 PRIMER

- A. Primer: SSPC-Paint 25, Type II, iron oxide, zinc oxide, raw linseed oil, and alkyd.

- B. All structural steel exposed to weather, including the steel at porte cochere or drive thru structure, shall be hot dipped galvanized unless noted otherwise on architectural drawings to receive special weathering paint.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- F. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened for standard bearing connections and Pretensioned as required at locations indicated on drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.
- D. All brick relief angles and loose lintels shall be hot dipped galvanizes unless noted otherwise on plan.

2.8 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
- B. Base and leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and leveling plates. Clean bottom surface of base and leveling plates.
 - 1. Set base plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
- E. Splice members only where indicated on drawings. All other splice locations must have prior written approval from the Engineer of Record.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- I. All field welding performed on galvanized steel shall receive approved corrosion inhibitor paint or 'cold galvanization' coating after weldment is cooled.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened for standard bearing connections and Pretensioned where indicated on drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
 - 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- B. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.

END OF SECTION 05 12 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. This Section includes the following:
 - 1. Bollards
 - 2. Loose Bearing and Leveling Plates
 - 3. Access Ladder
- 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. Structural drawings for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items indicated to be cast into concrete.
 - 2. Structural drawings for installing loose lintels, anchor bolts, and other items indicated to be built into unit masonry.
 - 3. Division 06 Section "Rough Carpentry" for metal framing anchors.

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, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Paint products.
 - 3. Grout.
- 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.
 - 3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- C. Samples for Verification: For each type and finish of extruded nosing and tread.
- D. Welding certificates.
- E. Qualification Data: For professional engineer.

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."

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 angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 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.

2.2 FERROUS METALS

- A. 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.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 316 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; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
 - 1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.
- D. Machine Screws: ASME B18.6.3.
- E. Lag Bolts: ASME B18.2.1.
- F. Wood Screws: Flat head, ASME B18.6.1.
- G. Plain Washers: Round, ASME B18.22.1.
- H. Lock Washers: Helical, spring type, ASME B18.21.1.
- I. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- J. Expansion Anchors: Anchor bolt and sleeve assembly 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.

2.4 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.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- 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, unless otherwise indicated.

2.5 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, 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 straightedges.
- 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, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 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.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Prime plates with zinc-rich primer.

2.8 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe 1/4-inch wall-thickness steel shapes, as indicated.

2.9 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3
- B. Steel Ladders:
 - 1. Space side rails 18 inches apart unless otherwise indicated.
 - 2. Side rails: Continuous, C3x5 channel
 - 3. Rungs: 3/4-inch-diameter steel bars.
 - 4. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
 - 5. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
 - 6. Support each ladder at top and bottom and not more than 60 inches o.c., unless noted otherwise, with welded or bolted steel brackets.

2.10 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) and Items Indicated to Receive Zinc-Rich Primer: 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.

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 bolts, 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.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 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 dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- C. 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 05 51 00 - METAL STAIRS AND RAILINGS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Provide custom-fabricated steel stairs and guardrails as indicated in construction drawings. Stairs assemblies shall include pre-fabricated, bolt-on concrete treads.
- B. Submittals: Shop Drawings and structural analysis data signed and sealed by a qualified professional engineer registered in the state where Project is located.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide custom-fabricated steel stairs and guardrails as indicated in construction drawings. Stairs assemblies shall include pre-fabricated, bolt-on concrete treads.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide stairs capable of withstanding a uniform load of 100 lbf/sq. ft. and a concentrated load of 300 lbf applied on an area of 4 sq. in.. Uniform and concentrated loads need not be assumed to act concurrently.
- B. Provide railings capable of withstanding a uniform load of 50 lbf/ft. and a concentrated load of 200 lbf applied to handrails and top rails of guards in any direction. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Provide railing infill capable of withstanding a concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.. Infill load and other railing loads need not be assumed to act concurrently.

2.3 METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 513.
- C. Rolled Steel Floor Plate: ASTM A 786/A 786M.

2.4 MISCELLANEOUS MATERIALS

- A. Pre-fabricated, bolt-on concrete treads.

2.5 FABRICATION

- A. General: Shear and punch metals cleanly and accurately. Remove burrs and ease exposed edges. Form bent-metal corners to smallest radius possible without impairing work.
- B. Welding: Use materials and methods that minimize distortion and develop strength of base metals. At exposed connections, finish welds and surfaces smooth.
- C. Stair Framing: Fabricate stringers of steel channels.

- D. Steel Tube Railings: Fabricate railings to comply with requirements indicated, but not less than that needed to withstand indicated loads.
 - 1. Configuration: 1-1/2-inch-square top and bottom rails, 1-1/2-inch-square posts, and 3/4-inch-square pickets spaced less than 4 inches clear.
 - 2. Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose.
 - 3. Form changes in direction of railings by bending or by inserting prefabricated fittings.
 - 4. Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
 - 5. Connect posts to stair framing by direct welding.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal stairs after assembly.
- B. Hot-dip galvanize steel stairs at exterior locations.
- C. Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning," and paint with a fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints. 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. Attach handrails to wall with wall brackets. Use type of bracket with predrilled hole for exposed bolt anchorage.

END OF SECTION 05 51 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Refer to structural drawings and specifications for information.
- B. Submittals: ICC-ES evaluation reports for wood-preserved treated wood, fire-retardant treated wood and engineered wood products.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Refer to structural drawings and specifications for information

2.2 TREATED MATERIALS

2.3 Refer to structural drawings and specifications for information.

2.4 MISCELLANEOUS LUMBER

- A. Refer to structural drawings and specifications for information.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, Exposure 1, C-D Plugged, fire-retardant treated, not less than 3/4-inch nominal thickness.

2.6 MISCELLANEOUS PRODUCTS

- A. Fasteners: Refer to structural drawings and specifications for additional information
- B. Sill Sealer: Closed-cell neoprene foam, 1/4 inch thick.
- C. Flexible Flashing: Self-adhesive product consisting of a butyl rubber or rubberized-asphalt compound, bonded to a backing sheet to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Do not splice structural members between supports unless otherwise indicated.
- D. Securely attach rough carpentry to substrates, complying with the following:

1. CABO NER-272 for power-driven fasteners.
2. Published requirements of metal framing anchor manufacturer.
3. Table 2304.9.1, "Fastening Schedule," in the IBC.

END OF SECTION 06 10 00

06 11 00 - WOOD FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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. Section Includes:
 - 1. Framing with dimension lumber.
 - 2. Framing with engineered wood products.
 - 3. Shear wall panels.
 - 4. Wood blocking, and nailers.
- B. Related Requirements:
 - 1. Division 31 Section "Termite Control" for site application of borate treatment to wood framing.
 - 2. Division 06 Section "Sheathing."

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. SPIB: The Southern Pine Inspection Bureau.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- B. All lumbers shall be straight and plumb at installation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency

certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

C. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

D. All lumbers shall be straight and plumb at installation up to Length/400 or 3/8" whichever governs. Contractor shall take all precautions in handling, shipping, and storage to ensure the straightness and plumbness of lumber at installation; non-straight and non-plumb lumber shall be rejected and shall be at contractor's cost.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Inorganic boron (SBX) not permitted for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all rough carpentry exposed to weather and as indicated in drawings, including but not limited to:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood floor plates that are installed over concrete slabs-on-grade.
5. All wood within 8" of exposed earth.

2.3 DIMENSION LUMBER FRAMING

A. Load-Bearing Partitions: See structural drawings, No.2 grade or better.

1. Application: Exterior walls and interior load-bearing partitions.
2. Species – See structural drawings.

2.4 ENGINEERED WOOD PRODUCTS

- A. Engineered Wood Products, General: Products shall comply with manufacturer's published design values.
- B. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
- C. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
 1. Extreme Fiber Stress in Bending, Edgewise: See structural drawings.
 2. Modulus of Elasticity, Edgewise: See structural drawings.

2.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Cants.
- B. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Wood Screws: ASME B18.6.1.
- D. Lag Bolts: ASME B18.2.1.

2.7 METAL FRAMING ANCHORS

- A. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated on drawings. If not indicated, provide connector of appropriate type to meet the framing condition and assume fastener is fully nailed to achieve maximum capacity in gravity and uplift. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- D. See structural drawings for hold down, strap ties, and connectors requirements.

2.8 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
- D. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. All structural wood walls or walls shown in structural drawings are designed to be conventionally constructed in field or so called 'stick framed'; they are not designed to be constructed in panels and assembled in field, or so called 'panelized construction'. Should the selected contractor decide to construct the walls in panels, approval shall be obtained from Engineer of Record. Contractor shall submit signed and sealed proposed connection details along with signed and sealed calculations at each panels, panels to top plate connection, floor-floor straps, etc. Connections shall satisfy all gravity and lateral load path. The design lateral load shall be the capacity of shear wall sheathing shown in structural drawings.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- G. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
- J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.
- B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 1. For load-bearing walls, provide double-jamb studs for all openings. Unless noted otherwise in structural drawings, provide (3)2x12 headers at all openings.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 11 00

SECTION 061600 - SHEATHING (HEW ZIP SYSTEM)

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. Combination wall sheathing, water resistive barrier and air barrier..
2. Combination roof sheathing and roof underlayment.
3. Self-adhering flexible flashing.
4. Liquid-applied flashing membrane.

- B. Related Requirements:

1. Section 061000 "Rough Carpentry".
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.
3. Section 072700 "Air Barriers".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. For panels with integral water resistive barrier, include data on air/-moisture-infiltration protection based on testing according to referencing standards.

- B. LEED Submittals:

1. Inputs for EA Prerequisite 2 and Credit EA 1; Proposed design input for exterior wall construction with air barrier performance taken into consideration.
2. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
3. Certificates for Credit MR 5.1 or 5.2: Certificates verifying that materials were extracted, processed, and manufactured within 500 miles of the project site.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Capable of demonstrating that all wood procurement operations are conducted in accordance with procedures and policies of the Sustainable Forestry Initiative (SFI) Program.
- B. Code Compliance: Comply with requirements of the following:
 - 1. International Code Council (ICC), ICC-ESR1473 (ZIP System Roof Sheathing).
 - 2. International Code Council (ICC), ICC-ESR1474 (ZIP System Wall Sheathing).
 - 3. International Code Council (ICC), ICC-ESR2227 (ZIP System Tape).
 - 4. Florida Building Code Compliance: Provide sheathing complying with Florida Building Code product and installation requirements for locations outside of high velocity wind zone.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Outdoor Storage: Comply with manufacturer's recommendations.
 - 1. Set panel bundles on supports to keep off ground.
 - 2. Cover panels loosely with waterproof protective material.
 - 3. Anchor covers on top of stack, but keep away from sides and bottom to assure adequate air circulation.
 - 4. When high moisture conditions exist, cut banding on panel stack to prevent edge damage.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sheathing system that fail due to manufacturing defects within specified warranty period.
 - 1. Construction Period Warranty: Manufacturer shall warrant the panels and tape for weather exposure for a period of 180 days from installation.
 - 2. System Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from **UL's U356**

2.2 WOOD PANEL PRODUCTS

- A. Oriented Strand Board: DOC PS 2-10.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated. Thickness shall satisfy minimum and maximum requirements for referenced performance category.
- C. Factory mark panels to indicate compliance with applicable standard.

2.3 COMBINATION WALL SHEATHING, WATER-RESISTIVE BARRIER, AND AIR BARRIER

- A. Oriented-Strand-Board Wall Sheathing: With integral water-resistive barrier, Exposure 1 sheathing.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Huber Engineered Woods LLC; ZIP System Roof and Wall Sheathing
 - 2. Span Rating, Panel Grade and Performance Category: Refer to Structural drawings
 - 3. Edge Profile: **[Square edge]**
 - 4. Provide fastening guide on top panel surface with pre-spaced fastening symbols for 16-inches (406 mm) and 24-inches (610 mm) on centers spacings.
 - 5. Performance Standard: DOC PS2-10 and ICC-ES ESR-1474.
 - 6. Factory laminated integral water-resistive barrier facer.
 - 7. Perm Rating of Integral Water-Resistive Barrier: 12-16 perms.
 - 8. Assembly maximum air leakage of 0.0072 cfm/sq. ft. (0.037 L/s x sq. m) infiltration and 0.0023 cfm/ sq. ft. (0.012 L/s x sq. m) exfiltration at a pressure differential of 1.57 (psf 75 Pa).
 - 9. Exposure Time: Designed to resist weather exposure for 180 days.

2.4 FASTENERS

- A. General: Provide fasteners of size and type that comply with requirements specified in this article by the authority having jurisdiction, International Building Code, International Residential Code, Wood Frame Construction manual, and National Design Specification.

2.5 MISCELLANEOUS MATERIALS

- A. Self-Adhering Seam and Flashing Tape: Pressure-sensitive, self-adhering, cold-applied, proprietary seam tape consisting of polyolefin film with acrylic adhesive.
 - 1. Basis-of-Design Product: Subject to compliance with requirements provide Huber Engineered Woods; ZIP System Seam and Flashing Tape
 - 2. Thickness: 0.012 inch (0.3 mm).
 - 3. Width: **[3.75 inch (95.3 mm)] [6 inch (152.4 mm)]**.
 - 4. Code Compliance: Comply with requirements of authorities having jurisdiction and ICC Evaluation Service, Inc. "AC148 - Acceptance Criteria for Flexible Flashing Materials."

5. International Code Council (ICC), ICC-ES ESR2227 (ZIP System Tape).
6. American Architectural Manufacturer's Association; AAMA 711.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 1. ICC-ES 1539 or NES NER-272 for power-driven fasteners.
 2. Chapter 23 in ICC's "International Building Code."
 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate **wall** sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Only mechanically attached and drainable EIFS and exterior insulation should be used with ZIP System wall sheathing.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in American Wood Council, "ASD/LRFD Manual for Engineered Wood Construction," 2012 edition for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 1. Wall and Roof Sheathing:
 - a. Nail or staple to wood framing.
 - b. Screw to cold-formed metal framing.

- c. Space panels **1/8 inch (3 mm)** apart at edges and ends.
- d. Install fasteners **3/8 inch (9.5 mm)** to **1/2 inch (12.7 mm)** from panel edges.
- e. Space fasteners in compliance with requirements of authority having jurisdiction.

3.3 SHEATHING JOINT TREATMENT

- A. Seal sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Apply ZIP System proprietary seam tape to joints between sheathing panels.
 - 2. Utilize ZIP System tape gun or hard rubber roller provided by manufacturer to ensure tape is completely adhered to substrates.

3.4 FLEXIBLE OR LIQUID APPLIED FLASHING INSTALLATION

- A. Apply ZIP System Tape flexible flashing or ZIP System Liquid Flash liquid applied flashing membrane where indicated to comply with manufacturer's written instructions.
 - 1. After flexible flashing tape has been applied, roll surfaces with a hard rubber to ensure that flashing is completely adhered to substrates.
 - 2. Width for Flexible Flashing: **6 inch (154.4 mm)**.
 - 3. Apply liquid-applied flashing membrane at penetrations, gaps, and cracks to form continuous weathertight surface. Apply liquid membrane according to manufacturer's written instructions. Follow manufacturer's recommendation for integration with ZIP System Tape.

END OF SECTION 061600

06 16 60 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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. Wall sheathing.
 - 2. Roof sheathing.

1.3 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
 - 4. For building wrap, include data on air-/moisture-infiltration protection based on testing according to referenced standards.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

- A. Plywood: DOC PS 1, EXPOSURE 1, 48/24 span rated.
- B. Oriented Strand Board: DOC PS 2 EXPOSURE 1.
- C. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

- D. Factory mark panels to indicate compliance with applicable standard.
- E. All sheathing shall be APA rated to match spans indicated in structural drawings.

2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPAC9.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat all plywood, unless otherwise indicated.

2.3 WALL SHEATHING

- 1. Wall Sheathing: See structural drawings.

2.4 ROOF SHEATHING

- 1. Roof Sheathing: See structural drawings.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
 - 1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

2.6 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
 - 1. Use adhesives that have NO VOC content.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
 - 3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's "Uniform Building Code."
 - 4. Table 2305.2, "Fastening Schedule," in BOCA's "BOCA National Building Code."
 - 5. Table 2306.1, "Fastening Schedule," in SBCCI's "Standard Building Code."
 - 6. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
 - 7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's "International One- and Two-Family Dwelling Code."
- D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall and Roof Sheathing:
 - a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 06 16 60

06 17 53 - SHOP-FABRICATED WOOD TRUSSES

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. Wood roof trusses.
 - 2. Wood floor trusses, including transfer trusses.
 - 3. Wood girder trusses.
 - 4. Wood truss bracing.
- B. Related Requirements:
 - 1. Division 06 Section "Sheathing" for roof sheathing and subflooring.
 - 2. Division 31 Section "Termite Control" for site application of borate treatment to wood trusses.
- C. It is the responsibility of truss manufacturer to provide all truss web openings to allow mechanical duct penetrations and all other openings as specified in Structural and Architectural drawings. Opening size shall include additional space required for duct insulation and construction tolerance.

1.3 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For wood-preservative-treated lumber metal-plate connectors, metal truss accessories, and fasteners.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.
 - 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Shop Drawings: Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 2. Indicate sizes, stress grades, and species of lumber.
 3. Indicate locations of permanent and temporary bracing required to prevent buckling of individual truss members due to design loads.
 4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 6. Show splice details and bearing details.
 7. Show web opening size and location matching duct locations shown in Mechanical drawings and all openings specified in Structural and Architectural drawings.
 8. Shop drawings shall show coordination of location of plumbing penetrations, lights, and mechanical components, such as diffusers and louvers, etc. Truss manufacturer shall add trusses as needed to achieve the specified design criteria, and additional truss cost shall be included in the bid price.
- C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. At no point shall the truss spacing exceed 24" o.c. It is the truss manufacturer's responsibility to review the truss layout and spacing during bidding and to include the cost of additional trusses required to meet the specified design criteria. The truss supplier shall be responsible for additional truss cost due to reduced truss spacing to meet specified design criteria.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For metal connector-plate manufacturer.
- B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.
- C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss fabricating firm.
- D. Evaluation Reports: For the following, from ICC-ES:
1. Wood-preservative-treated lumber.
 2. Metal-plate connectors.
 3. Metal truss accessories.

1.6 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 - 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: As indicated in structural drawings.
 - 2. Maximum Deflection Under Design Loads:
 - a. Roof Trusses: Vertical deflection of 1/240 of span due to total load; 1/360 of span due to live load.
 - b. Floor Trusses: Vertical deflection of 1/240 of span due to total load; 1/480 of span due to live load.
 - c. Transfer Trusses: See Structural drawings.
 - d. General contractor shall provide the weight, dimensions, and cutsheet of all mechanical units at roof to the truss supplier. Truss supplier shall design all roof trusses for mechanical units, including their weights, uplift and overturning moment from lateral loads, in addition to all loadings specified in structural drawings.
- C. Comply with applicable requirements and recommendations of the following publications:
 - 1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
 - 2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."

3. TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
 3. Provide dressed lumber, S4S.
 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Minimum Chord Size for Roof Trusses: 2 by 6 inches nominal (38 by 140 mm actual) for both top and bottom chords.
- C. Minimum Specific Gravity for Top Chords: 0.50
- D. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Division 06 Section "Rough Carpentry."

2.3 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with the ground. Use Category UC3b for exterior construction not in contact with the ground.
 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all trusses unless otherwise indicated.

2.4 METAL CONNECTOR PLATES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Alpine Engineered Products, Inc.; an ITW company.
 2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
 3. CompuTrus, Inc.

4. Eagle Metal Products.
5. Jager Building Systems, Inc.; a Tembec/SGF Rexfor company.
6. MiTek Industries, Inc.; a subsidiary of Berkshire Hathaway Inc.
7. Robbins Engineering, Inc.
8. Truswal Systems Corporation; an ITW company.

- B. Source Limitations: Obtain metal connector plates from single manufacturer.
- C. General: Fabricate connector plates to comply with TPI 1.
- D. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 (Z180) coating designation; and not less than 0.036 inch (0.9 mm) thick.
1. Use for interior locations unless otherwise indicated.
- E. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
1. Use for wood-preserved-treated lumber and where indicated.
- F. Stainless-Steel Sheet: ASTM A 666, type 304, and not less than 0.035 inch (0.88 mm) thick.
1. Use for exterior locations and where indicated.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
 2. Where trusses are exposed to weather, in ground contact, made from pressure-preserved-treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

2.6 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Cleveland Steel Specialty Co.
 2. KC Metals Products, Inc.
 3. Phoenix Metal Products, Inc.
 4. Simpson Strong-Tie Co., Inc.
 5. USP Structural Connectors.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- E. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 1. Use for exterior locations and where indicated.
- F. Truss Tie-Downs (Hurricane or Seismic Ties): Provide ties as indicated on structural drawings.
- G. Roof Truss Clips to be designed and provided by truss manufacturer: Angle clips for bracing bottom chord of roof trusses at non-load-bearing walls, 1-1/4 inches (32 mm) wide by 0.050 inch (1.3 mm) thick. Clip is fastened to truss through slotted holes to allow for truss deflection.
- H. Floor Truss Hangers to be designed and provided by truss manufacturer: U-shaped hangers, full depth of floor truss, with 1-3/4-inch- (44-mm-) long seat; formed from metal strap 0.062 inch (1.6 mm) thick with tabs bent to extend over and be fastened to supporting member.
- I. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches (38 mm) wide by 1 inch (25 mm) deep by 0.040 inch (1.0 mm) thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.
- B. Protective Coatings: SSPC-Paint 22, epoxy-polyamide primer.

2.8 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

2.9 SOURCE QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections.
 - 1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
 - 2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.
- B. Correct deficiencies in Work that special inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prior to installation, contractor shall coordinate with truss manufacturer for location of plumbing penetrations, lights, and mechanical components, such as diffusers and louvers, etc. Truss manufacturer shall add trusses as needed to achieve the specified design criteria, and additional truss cost shall be included in the bid price.
- B. Install wood trusses only after supporting construction is in place and is braced and secured.
- C. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- D. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- E. Install and brace trusses according to TPI recommendations and as indicated.
- F. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- G. Space trusses as indicated; adjust and align trusses in location before permanently fastening.
- H. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- I. Securely connect each truss ply required for forming built-up girder trusses.
 - 1. Anchor trusses to girder trusses per truss manufacturer.
- J. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install bracing to comply with Division 06 Section "Rough Carpentry"
 - 2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

- K. Install wood trusses within installation tolerances in TPI 1.
- L. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- M. Replace wood trusses that are damaged or do not meet requirements.
 - 1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.2 REPAIRS AND PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- D. Protective Coating: Clean and prepare exposed surfaces of metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.
 - 1. Apply materials to provide minimum dry film thickness recommended by coating system manufacturer.

END OF SECTION 06 17 53

SECTION 06 20 00 - FINISH CARPENTRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product data and profiles for siding, moldings and trim.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.
- B. Softwood Plywood: DOC PS 1.
- C. MDF: ANSI A208.2, Grade 130, made with binder containing no urea-formaldehyde resin.
- D. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea-formaldehyde resin.
- E. Certified Wood: Wood-based materials produced from tropical forests shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

2.2 EXTERIOR FINISH CARPENTRY

- A. Exterior Trim: Fiber-cement trim products. In sizes indicated on drawings.

2.3 INTERIOR STANDING AND RUNNING TRIM

- A. Interior Trim: MDF or finger-jointed pine. In sizes indicated on drawings.

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners for Exterior Finish Carpentry: hot-dip galvanized steel.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer.
 - 1. Wood glue shall have a VOC content of 30 g/L or less.
 - 2. Use waterproof resorcinol glue for exterior applications.
- C. Insect Screening for Soffit Vents: Aluminum
- D. Continuous Soffit Vents: Aluminum hat channel shape with stamped louvers or perforations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Condition interior finish carpentry in installation areas for 24 hours before installing.

- B. Prime and back-prime lumber for painted finish exposed on the exterior. Cut to length and prime ends.
- C. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Scribe and cut to fit adjoining work. Refinish and seal cuts.
 - 1. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 - 2. Install stairs with no more than 3/16-inch variation between adjacent treads and risers and with no more than 3/8-inch variation between largest and smallest treads and risers within each flight.
- D. Install standing and running trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary. Stagger joints in adjacent and related trim. Cope at returns and inside corners and miter at outside corners.
- E. Nail siding at each stud. Do not allow nails to penetrate more than one thickness of siding, unless otherwise recommended by siding manufacturer. Seal joints at inside and outside corners and at trim locations.

END OF SECTION 06 20 00

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data
- B. Surface-Burning Characteristics: According to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

PART 2 - PRODUCTS

2.1 INSULATION PRODUCTS

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV with flame-spread and smoke-developed indexes of 75 and 450, respectively.
 - 1. Manufacturers:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. Pactiv Building Products.
- B. Glass-Fiber-Blanket Insulation: ASTM C 665, Type I, un-faced with flame-spread and smoke-developed indexes of 25 and 450, respectively. Refer to drawings for required R-Value.
 - 1. Manufacturers:
 - a. CertainTeed Corporation.
 - b. Guardian Building Products, Inc.
 - c. Johns Manville.
 - d. Knauf Insulation.
 - e. Owens Corning.
- C. Cellulosic-Fiber Loose-Fill Insulation: ASTM C 739; chemically treated for flame-resistance, processing, and handling characteristics.
- D. Glass-Fiber Loose-Fill Insulation: ASTM C 764, Type 1, pneumatic application, with flame-spread and smoke-developed indexes of 25 and 450, respectively.
- E. Structural Insulated Sheathing (SIS): Structural wall sheathing panels with integral rigid insulation, with minimum R-Value of 3. Refer to structural drawings for sheathing requirements.

2.2 ACCESSORIES

- A. Vapor Retarder: Polyethylene 10 mils thick.
- B. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed to fit between roof framing members and to provide cross-ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install insulation in areas and in thicknesses indicated or required to produce R-values indicated. Cut and fit tightly around obstructions and fill voids with insulation.
- B. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
- C. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
- D. Except for loose-fill insulation and insulation that is friction fitted in stud cavities, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- E. Place loose-fill insulation to comply with ASTM C 1015.
 - 1. Comply with the CIMA's Special Report #3, "Standard Practice for Installing Cellulose Insulation."
- F. Spray-Applied Insulation: Apply insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs.
- G. Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage. Locate seams at framing members, overlap, and seal with tape. Seal joints caused by pipes, conduits, electrical boxes, and similar items with tape.

END OF SECTION 07 21 00

SECTION 07 46 33 - VINYL SOFFITS

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 vinyl soffit.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood furring, grounds, nailers, and blocking.
 - 2. Section 07 92 00 "Joint Sealants."

1.3 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples for Initial Selection: For vinyl soffit including related accessories.
- C. Samples for Verification: For each type, color, texture, and pattern required.
 - 1. 12-inch-long-by-actual-width Sample of soffit.
 - 2. 12-inch-long-by-actual-width Samples of trim and accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For vinyl siding Installer.
- B. Product Certificates: For each type of vinyl soffit.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish full lengths of vinyl soffit including related accessories, in a quantity equal to 2 percent of amount installed.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials under cover.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking, fading, and deforming.
 - b. Deterioration of materials beyond normal weathering.
 - 2. Fading is defined as loss of color, after cleaning with product recommended by manufacturer, of more than 7 Hunter color-difference units as measured according to ASTM D 2244.
 - 3. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 VINYL SOFFIT

- A. Vinyl Soffit: Integrally colored product complying with ASTM D 4477.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. CertainTeed Corporation; Ironmax
 - b. Gentek Building Products, Inc.
 - c. Norandex Building Materials Distribution, Inc.
 - d. Royal Building Products.
- B. Vinyl Siding Certification Program: Provide products that are listed in VSI's list of certified products.
- C. Pattern: 8-inch exposure in V-grooved, double, 4-inch board style.
- D. Texture: Smooth or Wood grain; to be selected by Owner.
- E. Ventilation: Provide perforated soffit unless otherwise indicated.
- F. Nominal Thickness: 0.044 inch.
- G. Minimum Profile Depth: 5/8 inch
- H. Colors: As selected by Architect from manufacturer's full range of colors.

2.3 ACCESSORIES

- A. Vinyl Accessories: Integrally colored vinyl accessories complying with ASTM D 3679 except for wind-load resistance.
 - 1. Texture: Smooth .
- B. Colors for Decorative Accessories: Match adjacent soffit.
- C. Fasteners:
 - 1. For fastening to wood, use siding nails or ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch into substrate.
 - 2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
 - 3. For fastening vinyl, use aluminum fasteners. Where fasteners are exposed to view, use prefinished aluminum fasteners in color to match item being fastened.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of vinyl soffit and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Center nails in elongated nailing slots without binding siding to allow for thermal movement.
- B. Install vinyl soffit and related accessories according to ASTM D 4756.
 - 1. Install fasteners for horizontal vinyl siding no more than 16 inches o.c.
- C. Install joint sealants as specified in Section 07 92 00 "Joint Sealants" and to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 07 46 33

SECTION 07 46 46 – FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, Samples, and ICC-ES evaluation reports.
- B. Warranties: Manufacturer's standard from in which siding manufacturer agrees to repair or replace siding that fails in materials or workmanship within 30 years. Failures include, but are not limited to, cracking, deforming or otherwise deteriorating beyond normal weathering.

PART 2 - PRODUCTS

2.1 SIDING

- A. Fiber-Cement Siding: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84. Factory primed.
 - 1. Manufacturers:
 - a. Allura USA
 - b. CertainTeed Corp.
 - c. GAF Materials Corporation.
 - d. James Hardie Building Products, Inc.
 - e. MaxiTile, Inc; a California corporation.
 - f. Nichiha Fiber Cement.
 - g. Norandex Building Materials Distribution, Inc.
 - 2. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186.
 - 3. Horizontal Pattern: As indicated on drawings
 - 4. Vertical Pattern: As indicated on drawings

2.2 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner trim, and other items as recommended by siding manufacturer for building configuration.
 - 1. Provide accessories made from same material as adjacent siding unless otherwise indicated.
- B. Decorative Accessories: Refer to drawings for profiles required and "Basis of Design".
 - 1. Louvers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fiber-cement siding, trim, soffit and related accessories per manufacturer's guidelines and instructions.

END OF SECTION 07 46 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. Adhered thermoplastic polyolefin (TPO) roofing system.
 - 2. Vapor retarder.
 - 3. Roof insulation.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
 - 2. Section 06 16 00 "Sheathing" for wood-based, structural-use roof deck panels.
 - 3. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. 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 affects 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.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:

1. Sheet roofing, of color required.
2. Walkway pads or rolls, of color required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
1. Submit evidence of compliance with performance requirements.
- C. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.
1. The applicator must be approved by the manufacturer of the accepted roofing system
 2. A single applicator with a minimum of five (5) years previous successful experience in installations of similar systems.
 3. Minimum of five (5) years experience in single-ply roofing with two (2) years experience seaming the system proposed.
 4. Be present at the jobsite at all times when work is being performed. Supervise workers as required to ascertain workmanship, progress, and adherence to details.
 5. Be responsible for schedule and coordination.
 6. Have authority to make binding commitments upon Contractor in the field.
 7. Have staff available 24/7 during construction through substantial completion to response immediately on site to address any situations that arise on the project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 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.

1.10 FIELD 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.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roofing, base flashings, roof insulation, fasteners, cover boards, roofing accessories, and other components of roofing system.
 - 2. Warranty Period: Thirty (30) years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as 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 (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carlisle SynTec Incorporated.
 - 2. Firestone Building Products.
 - 3. Johns Manville; a Berkshire Hathaway company.
 - 4. Mule-Hide Products Co., Inc.
- B. Source Limitations: Obtain components including roof insulation and fasteners approved by membrane roofing manufacturer.

2.2 REGULATORY AND PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements
 - 1. Classified by Factory Mutual as Class 1 Assembly
 - 2. Classified by Underwriters Laboratories, Inc as a Class A Assembly.
 - 3. Classified by Factory Mutual to meet I-90 Requirements.
 - 4. Follow local, state, and Federal regulations, safety standards and codes..
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 TPO ROOFING

- A. Fabric-Reinforced TPO Sheet: ASTM D 6878, internally fabric- or scrim-reinforced, uniform, flexible fabric-backed TPO sheet.
 - 1. Thickness: 60 mils, nominal.
 - 2. Exposed Face Color: Tan or White; to be selected by Architect.

2.4 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.
- 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 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, prepunched.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to 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.

2.5 ROOF INSULATION

- A. General: Preformed roof insulation boards manufacture or approved by TPO roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.

- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Carlisle SynTec Incorporated (HP-H Polyiso)
 - b. Firestone Building Products.
 - c. Johns Manville; a Berkshire Hathaway company.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - 3. Full-spread spray-applied, low-rise, two-component urethane adhesive.

2.7 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. 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.

3.4 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
 - 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- H. Install slip sheet over insulation and immediately beneath roofing or per manufacturer's recommendations.

3.5 ADHERED ROOFING INSTALLATION

- A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align 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 roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.
- E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roofing with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of 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.
 - 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 do not comply with requirements.
- H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.6 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.7 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 roofing system where inspections indicate that they do not comply with specified requirements.

3.8 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.9 ROOFING INSTALLER'S WARRANTY

This information shall be provided by the General Contractor "Roofing sub-contractor"

- A. WHEREAS Roofing Sub-Contractor, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: LDG Development
 - 2. Address: as noted on documents

3. Building Name/Type: As noted on documents
 4. Area of Work: Low slope areas.
 5. Acceptance Date: Substantial Completion; As noted by Contractor.
 6. Warranty Period: Two (2) years.
 7. Expiration Date: As noted by Warranty.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding 90mph;
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract

directly with Owner or a subcontract with Owner's General Contractor.

END OF SECTION 07 54 23

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Shop Drawings.
- B. Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- C. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leak-proof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 SHEET METAL

- A. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, not less than 0.032 inch thick; and finished as follows:
 - 1. Finish: Manufacturer's standard selection.
 - 2. Concealed Finish: Manufacturer's standard white or light-colored acrylic or polyester backer finish.
- B. Metallic-Coated Steel Sheet: Galvanized structural-steel sheet, ASTM A 653/A 653M, G90, or aluminum-zinc alloy-coated structural-steel sheet, ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; 26 gauge nominal thickness.

2.2 ACCESSORIES

2.3 FABRICATION

- A. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.
- B. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with butyl sealant concealed within joints.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with SMACNA's "Architectural Sheet Metal Manual." Allow for thermal expansion; set true to line and level. Install Work with laps, joints, and seams permanently watertight and weatherproof; conceal fasteners where possible.
- B. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

- C. Fabricate nonmoving seams in sheet metal with flat-lock seams. For aluminum, form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- D. Aluminum Flashing and Trim: Coat back side of aluminum flashing and trim with bituminous coating where it will contact wood, ferrous metal, or cementitious construction.
- E. Separate dissimilar metals with a bituminous coating or polymer-modified, bituminous sheet underlayment.

END OF SECTION 07 62 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Installer certificates signed by Installer certifying that products have been installed in compliance with requirements.

PART 2 - PRODUCTS

2.1 PENETRATION FIRESTOPPING

- A. Manufacturers:
 - 1. A/D Fire Protection Systems Inc.
 - 2. Grace Construction Products.
 - 3. Hilti, Inc.
 - 4. Johns Manville.
 - 5. Nelson Firestop Products.
 - 6. NUCO Inc.
 - 7. Passive Fire Protection Partners.
 - 8. RectorSeal Corporation.
 - 9. Specified Technologies Inc.
 - 10. 3M Fire Protection Products.
 - 11. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - 12. USG Corporation.
- B. Provide penetration firestopping materials that are compatible with one another, substrates, and penetrating items if any.
- C. Penetrations in Fire-Resistance-Rated Walls and Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating at Fire-Resistance-Rated Walls: Not less than that of construction penetrated.
 - 2. F-Rating at Horizontal Assemblies: At least 1 hour, but not less than that of construction penetrated.
 - 3. T-Rating at Horizontal Assemblies: At least 1 hour, but not less than the fire-resistance rating of construction penetrated except for penetrations within the cavity of a wall.
- D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Owner will engage a qualified testing agency to perform tests and inspections.

END OF SECTION 07 84 13

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and color Samples.
- B. Environmental Limitations: Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS

- A. Low-Emitting Materials: All adhesives, caulks and sealants used on the interior of the building shall comply with South Coast Air Quality Management District Rule #1168. Acceptable volatile organic compound (VOC) limits are listed in the table provided at the following web address: <http://www.arb.ca.gov/DRDB/SC/CURHTML/R1168.PDF>.
- B. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under service and application conditions.
- C. Sealant for General Exterior Use Where Another Type Is Not Specified, provide one of the Following:
 - 1. Single-component, nonsag polysulfide sealant, ASTM C 920, Type S; Grade NS; Class 25; for Use NT.
 - 2. Single-component, neutral-curing silicone sealant, ASTM C 920, Type S; Grade NS; Class 25; for Use NT.
 - 3. Single-component, nonsag urethane sealant, ASTM C 920, Type S; Grade NS; Class 25; and for Use NT.
- D. Sealant for Exterior Traffic-Bearing Joints, Where Slope Allows Use of Pourable Sealant:
 - 1. Single-component, pourable urethane sealant, ASTM C 920, Type S; Grade P; Class 25; for Use T.
- E. Sealant for Use in Interior Joints in Ceramic Tile and Other Hard Surfaces in Kitchens and Toilet Rooms and Around Plumbing Fixtures:
 - 1. Single-component, mildew-resistant silicone sealant, ASTM C 920, Type S; Grade NS; Class 25; for Use NT; formulated with fungicide.
- F. Sealant for Interior Use at Perimeters of Door and Window Frames:
 - 1. Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
- G. Acoustical Sealant:
 - 1. Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission as demonstrated by testing according to ASTM E 90.

2.2 MISCELLANEOUS MATERIALS

- A. 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, 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.
- D. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 1193.
- B. Install sealant backings to support sealants during application and to produce cross-sectional shapes and depths of installed sealants that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal perimeters, control joints, openings, and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions. Comply with ASTM C 919.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Shop Drawings.

PART 2 - PRODUCTS

2.1 HOLLOW METAL DOORS AND FRAMES

- A. Manufacturers:
 - 1. Amweld Building Products, LLC.
 - 2. Benchmark; a division of Therma-Tru Corporation.
 - 3. Ceco Door Products; an Assa Abloy Group company.
 - 4. Curries Company; an Assa Abloy Group company.
 - 5. Deansteel Manufacturing Company, Inc.
 - 6. Firedoor Corporation.
 - 7. Fleming Door Products Ltd.; an Assa Abloy Group company.
 - 8. Habersham Metal Products Company.
 - 9. Karpen Steel Custom Doors & Frames.
 - 10. Mesker Door Inc.
 - 11. Pioneer Industries, Inc.
 - 12. Republic Doors and Frames
 - 13. Security Metal Products Corp.
 - 14. Steelcraft; an Ingersoll-Rand company.
 - 15. Masonite Corporation
- B. Fire-Rated Doors and Frames: Labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, based on testing at positive pressure according to NFPA 252 or UL 10C.
- C. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- D. Doors: Complying with SDI A250.8 for level and model and SDI A250.4 for physical-endurance level indicated, 1-3/4 inches thick unless otherwise indicated.
- E. Frames: ANSI A250.8; conceal fastenings unless otherwise indicated.
- F. Glazing Stops: Non-removable stops on outside of exterior doors and on secure side of interior doors; screw-applied, removable, glazing stops on inside, fabricated from same material as door face sheet in which they are installed.
- G. Prepare doors and frames to receive mortised and concealed hardware according to SDI A250.6 and BHMA A156.115.
- H. Prime Finish: Manufacturer's standard, factory-applied coat of lead- and chromate-free primer complying with SDI A250.10 acceptance criteria.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, suitable for exposed applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install hollow metal frames to comply with SDI A250.11.
 - 1. Fire-Rated Frames: Install according to NFPA 80.
- B. Install doors to provide clearances between doors and frames as indicated in SDI A250.11.
- 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.

END OF SECTION 08 11 13

SECTION 08 14 23 - MOLDED WOOD DOORS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Section Includes: Interior and Exterior Door systems with door panels, door frame, and hinge components.
- B. Submittals: Product Data, Door Schedule

PART 2 - PRODUCTS

2.1 GENERAL

- A. Factory fit doors to suit frame-opening sizes indicated and to comply with clearances specified.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3.
- C. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
- D. Factory finish doors and frames with manufacturer's standard primer and opaque finish.
- E. Fabricate door frame with vinyl wrapped foam filled compression design.
- F. Fire-Rated Wood Doors: Labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.2 HOLLOW CORE MOLDED-HARDBOARD-FACED DOORS

- A. Basis of Design: Masonite Molded Panel Series Hollow Core Interior Doors
- B. Hollow-Core Doors with Hardboard Faces: Three-ply hollow cores with lock blocks on both sides.
- C. Door Panel: Loose lay-up assembly that includes molded wood fiber facings, wood or MDF rails and corrugated cell core. Door facings shall be bonded to stiles, rails and core forming a 3-ply structural attachment. Provide water-based latex primer on door facings.
 - 1. Thickness: 1 3/8" or 1 3/4"; refer to Door Schedule
 - 2. Hinges: 3 1/12" for 1 3/8" door; 4" for 1 3/4" door.
 - 3. Provide face bore for locks and dead-locks in the area of solid internal supports.
- D. Door Frame: Wood 2-piece split jamb. Prepare frame for hinges and strike
- E. Hinges: Provide 3 standard weight radius mortise hinges on doors up to 7'-0" height. Provide 4 hinges on doors greater than 7'-0".
- F. Sound transmission Class (STC) rating (1 3/8"): 27.
- G. Warranty: 1-year (limited)

2.3 WOOD-EDGE HD STEEL ENTRY DOORS

- A. Basis of Design:
 - 1. Masonite HD Wood-Edge High-Definition Steel Entry Doors; 20-minute rating
- B. Door Frame: Wood, single rabbet design. Machine frame for hinges, strike and weatherstripping.
- C. Door Panel Provide water-based latex primer on door facings.
 - 1. Faces: .0215-inch-thick hot-dipped galvanized steel.
 - 2. Core: High performance polyurethane foam (2.0 pcf)
 - 3. Thickness: 1 3/4"
 - 4. Hinges: 4"
 - 5. Provide face bore for locks and dead-locks in the area of solid internal supports.
 - 6. Weatherstripping: Fabricate bottom of door to receive weather seal.
 - 7. Panel Configuration: As indicated.
- D. Hinges: Provide 3 standard weight radius mortise hinges on doors up to 7'-0" height. Provide 4 hinges on doors greater than 7'-0".
- E. Sound transmission Class (STC) rating: 24 (solid door).
- F. Warranty: 5-year

2.4 STEEL-EDGE HD STEEL ENTRY DOORS

- A. Basis of Design:
 - 1. Masonite HD Steel-Edge High-Definition Steel Entry Doors; up to 90-minute rating.
- B. Core: High performance polyurethane foam (2.0 pcf)
- C. Weatherstripping: Fabricate bottom of door to receive weather seal.
- D. Door Frame: Wood, single rabbet design. Machine frame for hinges, strike and weatherstripping.
- E. Door Panel Provide water-based latex primer on door facings.
 - 1. Faces: .0215-inch-thick hot-dipped galvanized steel.
 - 2. Core: High performance polyurethane foam (2.0 pcf)
 - 3. Thickness: 1 3/4"
 - 4. Hinges: 4"
 - 5. Provide face bore for locks and dead-locks in the area of solid internal supports.
 - 6. Panel Configuration: As indicated.
- F. Hinges: Provide 3 standard weight radius mortise hinges on doors up to 7'-0" height. Provide 4 hinges on doors greater than 7'-0".
- G. Sound transmission Class (STC) rating: 22 (solid door).
- H. Warranty: 15-year

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with WDMA's "How to Store, Handle, Finish, Install, and Maintain Wood Doors."
 - 1. Install fire-rated doors to comply with NFPA 80.
- B. Align and fit doors in frames with uniform clearances and bevels.

END OF SECTION 08 14 23

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing per the following:
 - 1. Vertical Access Doors: NFPA 252 or UL 10B.
 - 2. Horizontal Access Doors and Frames: NFPA 288.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers:
 - 1. Acudor Products, Inc.
 - 2. Babcock-Davis.
 - 3. Cendrex Inc.
 - 4. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
 - 5. Jensen Industries; Div. of Broan-Nutone, LLC.
 - 6. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 - 7. Karp Associates, Inc.
 - 8. Lane-Aire Manufacturing Corp.
 - 9. Larsen's Manufacturing Company.
 - 10. Maxam Metal Products Limited.
 - 11. Metropolitan Door Industries Corp.
 - 12. MIFAB, Inc.
 - 13. Milcor Inc.
 - 14. Nystrom, Inc.
 - 15. Williams Bros. Corporation of America (The).
- B. Fire-Rated, Flush Access Doors with Exposed Flanges: Prime-painted steel self-latching units with automatic closer.
- C. Locks: Flush to finished surface, screwdriver operated.

2.3 MATERIALS

- A. Steel Sheets: ASTM A 1008/A 1008M or ASTM A 591/A 591M.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, with A60 or G60 coating.
- C. Stainless-Steel Sheets: ASTM A 666, Type 304, with No. 4 directional satin finish.
- D. Aluminum Sheet: ASTM B 209, Alloy 5005-H15.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install access doors and panels accurately in position. Adjust hardware and door and panels for proper operation.
- B. Install fire-rated access doors and panels according to NFPA 80.

END OF SECTION 08 31 13

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Shop Drawings.

PART 2 - PRODUCTS

2.1 OVERHEAD COILING DOORS

- A. Manufacturers:
 - 1. ACME Rolling Doors.
 - 2. Alpine Overhead Doors, Inc.
 - 3. AlumaTek, Inc.
 - 4. C.H.I. Overhead Doors.
 - 5. City-Gates.
 - 6. Clopay Building Products
 - 7. Cookson Company.
 - 8. Cornell Iron Works, Inc.
 - 9. Dynamic Closures Corp.
 - 10. Lawrence Roll-Up Doors, Inc.
 - 11. Mahon Door Corporation.
 - 12. McKeon Rolling Steel Door Company, Inc.
 - 13. Metro Door.
 - 14. Overhead Door Corporation.
 - 15. Raynor.
 - 16. Southwestern Steel Rolling Door Co.
 - 17. Wayne-Dalton Corp.
- B. Fire-Rated Doors: Labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.
 - 1. For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- C. Door Curtain Slats: Galvanized steel, flat-profile slats.
- D. Operation: Manual
- E. Tracks, Supports, and Hardware: Manufacturer's standard.
- F. Weatherseals: Provide replaceable weather stripping at bottom and at top of exterior doors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install door, track, and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports.

- B. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- C. Install fire-rated doors to comply with NFPA 80.
- D. Test and adjust controls and safeties.

END OF SECTION 08 33 23

SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, Shop Drawings, and color Samples.
 - 1. For entrance doors, include hardware schedule.

PART 2 - PRODUCTS

2.1 ALUMINUM-FRAMED STOREFRONTS

- A. Manufacturers:
 - 1. Arcadia, Inc.
 - 2. Arch Aluminum & Glass Co., Inc.
 - 3. CMI Architectural
 - 4. Commercial Architectural Products, Inc.
 - 5. EFCO Corporation.
 - 6. Kawneer North America; an Alcoa company.
 - 7. Leed Himmel Industries, Inc.
 - 8. Pittco Architectural Metals, Inc.
 - 9. TRACO.
 - 10. Tubelite.
 - 11. United States Aluminum.
 - 12. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
 - 13. YKK AP America Inc.
- B. Accessible Entrances: Comply with ICC A117.1.
- C. Performance Requirements:
 - 1. Limit deflection of framing members normal to wall plane to 1/175 of clear span or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 - 2. Limit deflection of framing members parallel to glazing plane to L/360 of clear span or 1/8 inch, whichever is smaller.
 - 3. Structural Testing: Systems tested according to ASTM E 330 at 150 percent of inward and outward wind-load design pressures do not evidence material failures, structural distress, deflection failures, or permanent deformation of main framing members exceeding 0.2 percent of clear span.
- D. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated; ASTM B 209 sheet; ASTM B 221 extrusions.
- E. Glazing: 1" Low-E, tempered glass.
- F. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
- G. Doors: 1-3/4-inch-thick glazed doors with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods. Provide snap-on extruded-aluminum glazing stops, and preformed gaskets.
 - 1. Door Design: As indicated

2. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
 3. Interior Doors: Provide BHMA A156.16 silencers, three on strike jamb of single-door frames and two on head of double-door frames.
 4. Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.
 5. Hardware: As specified in Section 08 71 00 "Door Hardware."
- H. Fasteners and Accessories: Compatible with adjacent materials, corrosion resistant, nonstaining, and nonbleeding. Use concealed fasteners except for application of door hardware.
- I. Fabrication: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.
1. Door Framing: Reinforce to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units for hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.
- J. Aluminum Finish: Class I, dark bronze anodic finish; complying with AAMA 611

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Isolate metal surfaces in contact with incompatible materials, including wood, by painting contact surfaces with bituminous coating or primer, or by applying sealant or tape recommended by manufacturer.
- B. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 "Joint Sealants" to produce weathertight installation.
- D. Install framing components true in alignment with established lines and grades to the following tolerances:
1. Variation from Plane: Limit to 1/8 inch in 12 feet; 1/4 inch over total length.
 2. Alignment: For surfaces abutting in line, limit offset to 1/16 inch. For surfaces meeting at corners, limit offset to 1/32 inch.
 3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.
- E. Install doors without warp or rack. Adjust doors and hardware to provide tight fit at contact points and smooth operation.

END OF SECTION 08 41 13

SECTION 08 53 13 – VINYL WINDOWS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, Shop Drawings, and color Samples.
- B. Provide AAMA- or WDMA-certified windows with an attached label.

PART 2 - PRODUCTS

- 2.1 All windows shall be Energy Star labeled with insulated, Low-E glazing. Windows must perform at or better than Rescheck/Comcheck values provided in drawings
- 2.2 All windows to be vinyl, single-hung. Basis-of-design product is Atrium Windows, Series 9001. Windows to come with screens (where operable) and grille pattern as shown on the elevations with grilles to be 3/4" sculpted between the glass. Hardware to be standard grade, in color to match windows. Window must have the following warranties: minimum 10-year for vapor seal at glazing; minimum 1-year for window operation
- 2.3 All windows must have an integral opening control device that complies with ASTM F 2090. Opening control device shall, after operation to release the control device allowing the window to full open, shall not reduce the minimum net clear opening area of the window below 5.7 square feet nor shall the opening control device reduce the minimum clear opening size below 24in high x 20in wide.
- 2.4 VINYL WINDOWS
 - A. Vinyl windows to be provided by, but not limited to, the following manufacturers:
 - 1. Atrium Windows and Doors
 - 2. Certainteed
 - 3. Crestwood
 - 4. Jeld-Wen
 - 5. Milgard
 - 6. Pella Corporation
 - 7. Marvin
 - B. Basis of Design: Atrium Window, Series 5700
 - C. Window Types: As indicated on Drawings.
 - 1. Single hung.
 - D. Window Color: To be selected by architect from standard options.
 - E. Equip units with grilles (between glass panes) as indicated.
 - F. Glazing: Provide insulated units with low-e coating on second or third surface.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set units level, plumb, and true to line, without warp or rack of frames and panels. Provide proper support and anchor securely in place.
- B. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.
- C. Adjust operating panels, screens, and hardware to provide a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
- D. Clean glass and vinyl surfaces immediately after installing windows. Remove nonpermanent labels from glass surfaces.

END OF SECTION 08 50 00

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Hardware schedule

PART 2 - PRODUCTS

2.1 HARDWARE

- A. Fire-Resistance-Rated Assemblies: Provide products that comply with NFPA 80 and are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for applications indicated. On exit devices provide label indicating "Fire Exit Hardware."
- B. Hinges:
1. Stainless-steel hinges with stainless-steel pins for exterior.
 2. Two hinges for 1-3/8-inch-thick wood doors.
 3. Three hinges for 1-3/4-inch-thick doors 90 inches or less in height; four hinges for doors more than 90 inches in height.
- C. Locksets and Latchsets:
1. Manufacturers:
 - a. Accurate Lock & Hardware Co.
 - b. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
 - c. Arrow USA; an ASSA ABLOY Group company.
 - d. Best Access Systems; Div. of Stanley Security Solutions, Inc.
 - e. Cal-Royal Products, Inc.
 - f. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.
 - g. Falcon Lock; an Ingersoll-Rand Company.
 - h. Hager Companies.
 - i. K2 Commercial Hardware; a Black & Decker Corp. company.
 - j. Marks USA.
 - k. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.
 - l. PDQ Manufacturing.
 - m. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - n. Schlage Commercial Lock Division; an Ingersoll-Rand company.
 - o. Weiser Lock Corp.; a Black & Decker Corp. company.
 - p. Yale Security Inc.; an ASSA ABLOY Group company.
 - q. Pamex Inc.
 2. BHMA A156.2, Series 4000, Grade 2 for bored locks and latches.
 3. BHMA A156.3, Grade 1 for exit devices.
 4. BHMA A156.5, Grade 2 for auxiliary locks.
 5. Lever handles on locksets and latchsets at all first floor doors. Knobs at upper floors.
 6. Provide trim on exit devices matching locksets.
- D. Key locks to Owner's new master-key system.
1. Cylinders with six-pin tumblers.
 2. Provide cylinders for storefront doors, and other locking doors that do not require other hardware.
 3. Provide construction keying.
 4. Provide key control system, including cabinet.

- E. Closers:
 - 1. Manufacturers:
 - a. Arrow USA; an ASSA ABLOY Group company.
 - b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - c. DORMA Architectural Hardware; Member of The DORMA Group North America.
 - d. Dor-O-Matic; an Ingersoll-Rand company.
 - e. K2 Commercial Hardware; a Black & Decker Corp. company.
 - f. LCN Closers; an Ingersoll-Rand company.
 - g. Norton Door Controls; an ASSA ABLOY Group company.
 - h. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
 - i. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - j. Yale Security Inc.; an ASSA ABLOY Group company.
 - k. Pamex Inc.
 - 2. Mount closers on interior side (room side) of door opening. Provide regular-arm, parallel-arm, or top-jamb-mounted closers as necessary.
 - 3. Adjustable delayed opening (accessible to people with disabilities) feature on closers.
- F. Provide wall stops or floor stops for doors without closers.
- G. Hardware Finishes:
 - 1. Hinges: Matching finish of lockset/latchset.
 - 2. Locksets, Latchsets, and Exit Devices: Satin stainless steel
 - 3. Closers: Aluminum enamel.
 - 4. Other Hardware: Matching finish of lockset/latchset.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount hardware in locations required to comply with governing regulations and according to SDI A250.8 and DHI WDHS.3.
- B. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet.
- C. Deliver keys to Owner.

END OF SECTION 08 71 00

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. 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 glazing for the following products, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Vision lites.
 - 2. Entrances, transoms, and sidelites.
 - 3. Storefront and curtain wall construction.
- B. Glazing types are as follows:
 - 1. Type A: 1" insulated glazing with low "E" coating.
 - 2. Type B: 1/4" tempered wireless fire glazing
 - 3. Type C: 1/4" tempered
 - 4. Type D: Refer to window or door specification for factory glazed products.
- C. Related Sections: The following sections contain requirements that relate to this Section.
 - 1. Division 8 Section "Hollow Metal Doors and Frames".
 - 2. Division 8 Section "Aluminum-Framed Entrances and Storefronts".
 - 3. Division 8 Section Vinyl Windows

1.3 SUBMITTALS

- A. Product data for each glass product and glazing material indicated.
- B. Product certificates signed by glazing materials manufacturers certifying that their products comply with specified requirements.
 - 1. Separate certifications are not required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program of a recognized certification agency or independent testing agency acceptable to authorities having jurisdiction.
- C. Compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.

1.4 QUALITY ASSURANCE

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. FGMA Publications: "FGMA Glazing Manual."
 - 2. LSGA Publications: "LSGA Design Guide."

3. SIGMA Publications: TM-3000 "Vertical Glazing Guidelines".
- B. Fire-Resistive Glazing Products for Door Assemblies: Products identical to those tested per ASTM E 152, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component lite of units with appropriate certification label of inspecting and testing agency indicated below:
 1. Insulating Glass Certification Council (IGCC).
 2. Associated Laboratories, Inc. (ALI).
 3. National Certified Testing Laboratories (NCTL).
- D. Glazier Qualifications: Engage an experienced glazier who has completed glazing similar in material, design, and extent to that indicated for Project with a record of successful in-service performance.
- E. Single-Source Responsibility for Glass: Obtain glass from one source for each product indicated below:
 1. Primary glass of each (ASTM C 1036) type and class indicated.
 2. Heat-treated glass of each (ASTM C 1048) condition indicated.
 3. Insulating glass of each construction indicated.
- F. Single-Source Responsibility for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
- G. Preconstruction Compatibility and Adhesion Testing: Submit to sealant manufacturers, samples of each glass, gasket, glazing accessory, and glass-framing member that will contact or affect glazing sealants for compatibility and adhesion testing as indicated below:
 1. Use test methods standard with sealant manufacturer to determine if priming and other specific preparation techniques are required for rapid, optimum glazing sealants adhesion to glass and glazing channel substrates.
 2. Investigate materials failing compatibility or adhesion tests and get sealant manufacturer's written recommendations for corrective measures, including using special primers.
 3. Testing is not required when glazing sealant mfr. can submit required preparation data that is acceptable to Architect and is based on previous testing of current sealant products for adhesion to and compatibility with submitted glazing materials.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 1. Install liquid sealants at ambient and substrate temperatures above 40 deg F (4.4 deg C).

1.7 WARRANTY

- A. General: Warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
- B. Manufacturer's Warranty on Coated Glass Products: Submit written warranty signed by coated glass manufacturer agreeing to furnish replacements for those coated glass units that deteriorate as defined in "Definitions" article, f.o.b. point of manufacture, freight allowed Project site, within specified warranty period indicated below. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to glass manufacturer's published instructions.
 - 1. Warranty Period: Manufacturer's standard but not less than **5 years** after date of Substantial Completion.
- C. Manufacturer's Warranty on Insulating Glass: Submit written warranty signed by manufacturer of insulating glass agreeing to furnish replacements for insulating glass units that deteriorate as defined in "Definitions" article, f.o.b. point of manufacture, freight allowed Project site, within specified warranty period indicated below. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, protecting, and maintaining practices contrary to glass manufacturer's published instructions.
 - 1. Warranty Period: Manufacturer's standard but not less than **10 years** after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the products specified in Product Data Sheets at end of this Section.

2.2 PRIMARY FLOAT GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Class as indicated below, and Quality q3 (glazing select).
- B. Refer to requirements for sealed insulating glass units for performance characteristics of assembled units composed of tinted glass, coated or uncoated, relative to visible light transmittance, U-values, shading coefficient, and visible reflectance.

2.3 HEAT-TREATED FLOAT GLASS PRODUCTS, GENERAL

- A. Fabrication Process: By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturer's option, except provide horizontal process where indicated as tongless or free of tong marks.

2.4 HEAT-TREATED FLOAT GLASS

- A. Uncoated, Clear, Heat-Treated Float Glass: ASTM C 1048, Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below.
 - 1. Kind HS (heat strengthened) where indicated.
 - 2. Kind FT (fully tempered) where indicated.

- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering heat-treated glass products that may be incorporated in the Work include, but are not limited to, the following companies.
1. AFG Industries, Inc.
 2. Falconer Glass Industries.
 3. Guardian Industries Corp.
 4. PPG Industries, Inc.
 5. Tempglass.
 6. Viracon, Inc.

2.5 MONOLITHIC GLASS PRODUCTS

- A. General: Performance characteristics designated for coated monolithic glass products are nominal values based on manufacturer's published test data for glass products 6.0 mm thick (0.23 inch thick), unless otherwise indicated. Comply with requirements specified including those for primary and heat-treated float glass products as they relate to properties of glass to which coatings are applied.
1. U-values are expressed as Btu/hour x sq. ft. x deg F.
 2. Provide Kind HS (heat-strengthened) coated float glass except provide Kind FT (fully tempered) products where coated safety glass is designated or required.
- B. Pyrolytically Coated Glass Products: Float glass with solar-reflective metallic oxide coating applied pyrolytically either during initial manufacture or during heat treatment, complying with requirements specified in Pyrolytically Coated Monolithic Glass Product Data Sheet at the end of this Section.

2.6 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F (250 deg C) temperature-rise limitation; and the fire-resistance rating in minutes.
1. Available manufacturers include the following:
 - a. AGC Glass Company North America Inc.
 - b. SAFTI FIRST Fire Rated Glazing Solutions
 - c. Technical Glass Products (TPG)
 - d. Vetrotech Saint-Gobain
 2. Basis of Design: SAFTI FIRST SuperLite I-XL
 - a. 1/4" thick
 - b. Tempered
 - c. Wireless

2.7 INSULATING GLASS PRODUCTS

- A. Sealed Insulating Glass Units: Preamsembled units consisting of organically sealed lites of glass separated by dehydrated air spaces complying with ASTM E 774 and with other requirements indicated, including those in Insulating Glass Product Data Sheet at the end of this Section.
1. For properties of individual glass lites making up units, refer to requirements specified elsewhere in this Section applicable to types, classes, kinds, and conditions of glass products comprising lites of insulating glass units.
 2. Provide heat-treated, coated float glass of kind indicated or, if not otherwise indicated, Kind HS (heat strengthened) where recommended by manufacturer to comply with system performance requirements specified and Kind FT (fully tempered) where safety glass is designated or required.

3. Performance characteristics designated for coated insulating glass are nominal values based on manufacturer's published test data for units with lites 6.0 mm (0.23 inch) thick and nominal 1/2-inch dehydrated space between lites, unless otherwise indicated.
4. U-values are expressed as Btu/hour x sq. ft. x deg F.

2.8 ELASTOMERIC GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
 1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturer's recommendations for selecting glazing sealants and tapes that are suitable for applications indicated and conditions existing at time of installation.
 3. Colors: Provide color of exposed joint sealants to comply with the following:
 - a. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.
- B. Glazing Sealant for Fire-Resistant Glazing Products: Identical to product used in test assembly to obtain fire-resistive rating.

2.9 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent, nonstaining and nonmigrating in contact with nonporous surfaces, with or without spacer rod as recommended by tape and glass manufacturers for application indicated, packaged on rolls with a release paper backing, and complying with AAMA 800 for products indicated below:
 3. AAMA 804.1.
- B. Available Products: Subject to compliance with requirements, glazing tape that may be incorporated in the Work include, but is not limited to, the following:
 3. Back-Bedding Mastic Glazing Tape Without Spacer Rod:
 - a. PTI 303 Glazing Tape (shimless), Protective Treatments, Inc.
 - b. S-M 5700 Poly-Glaze Tape Sealant, Schnee-Morehead, Inc.
 - c. Tremco 440 Tape, Tremco Inc.

2.10 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials involved for glazing application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85 plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side-walking).
- F. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonextruding, nonoutgassing, strips of closed-cell plastic foam of density, size, and shape to control sealant depth and otherwise contribute to produce optimum sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistive rating.

2.11 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine glass framing, with glazier present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
 - 2. Presence and functioning of weep system.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions as indicated on Drawings provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust by Project conditions during installation.
- C. Protect glass from edge damage during handling and installation as follows:
 - 1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by manufacturer's label.
 - 2. Remove damaged glass from Project site and legally dispose of off site. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

- E. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass sizes larger than 50 united inches (length plus height) as follows:
 - 1. Locate spacers inside, outside, and directly opposite each other. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that when compressed by glass their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously but not in one continuous length. Do not stretch tapes to make them fit opening.
- C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each lite is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 PROTECTION AND CLEANING

- H. Protect exterior glass from breakage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- I. Protect glass from contact with contaminating substances resulting from construction operations including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- J. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkali deposits, or stains, and remove as recommended by glass manufacturer.
- K. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents and vandalism, during construction period.
- L. Wash glass on both faces in each area of Project not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

3.6 PRODUCT DATA SHEETS

INSULATING GLASS PRODUCT DATA SHEET

Type A

Thickness: 1" Insulated Unit

Basis of Design: PPG Solarban 60 Solar Control Low-e glass.

Air Space Width: Nominal 1/2 inch measured perpendicularly from surfaces of glass lites at unit's edge.

Glass Specifications: Comply with the following requirements:

Thickness of Each Lite: 6.0 mm (0.23 inch) as indicated.

Coated Indoor Lite: Kind HS (heat-strengthened), Condition C (other coated glass), Class 1 (clear) float glass.

Low-Emissivity Coating: Pyrolytic or sputter-coat on second or third surface.

Nominal Performance Characteristics are as indicated below:

Visible Light Transmittance: $35 \pm 3\%$

Summer Daytime U-Value: $.28 \pm .03$

Winter Nighttime U-Value: $.29 \pm .03$

Shading Coefficient: $33 \pm .03$

Outdoor Visible Reflectance: $7\% \pm 3\%$

Light to Solar Gain (LSG): $1.25 \pm 3\%$

END OF SECTION 08 80 00

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing and inspecting agency.

2.2 PANEL PRODUCTS

- A. Provide in maximum lengths available to minimize end-to-end butt joints.
- B. Interior Gypsum Board: ASTM C 1396/C 1396M, in thickness indicated, with manufacturer's standard edges. Type X where indicated
 - 1. Manufacturers:
 - a. American Gypsum.
 - b. CertainTeed Corp.
 - c. Georgia-Pacific Gypsum LLC.
 - d. Lafarge North America Inc.
 - e. National Gypsum Company.
 - f. PABCO Gypsum.
 - g. Temple-Inland.
 - h. USG Corporation.
- C. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M, in thickness indicated, with manufacturer's standard edges. Type X where required for fire-resistance-rated assemblies and where indicated.
 - 1. Manufacturers:
 - a. American Gypsum.
 - b. CertainTeed Corp.
 - c. Georgia-Pacific Gypsum LLC.
 - d. Lafarge North America Inc.
 - e. National Gypsum Company.
 - f. PABCO Gypsum.
 - g. Temple-Inland.
 - h. USG Corporation.
- D. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, in thickness indicated. Type X where required for fire-resistance-rated assemblies and where indicated.
 - 1. Manufacturers:
 - a. American Gypsum.
 - b. CertainTeed Corp.

- c. Georgia-Pacific Gypsum LLC.
 - d. Lafarge North America Inc.
 - e. PABCO Gypsum.
 - f. Temple-Inland.
 - g. USG Corporation.
- E. Glass-Mat, Water-Resistant Gypsum Backing Board: ASTM C 1178/C 1178M, of thickness indicated. Type X where required for fire-resistance-rated assemblies and where indicated.
- 1. Products:
 - a. CertainTeed Corp.; GlasRoc Tile Backer.
 - b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.

2.3 ACCESSORIES

- A. Trim Accessories: ASTM C 1047, formed from galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet. For exterior trim, use accessories formed from hot-dip galvanized-steel sheet, plastic, or rolled zinc.
- 1. Provide cornerbead at outside corners unless otherwise indicated.
 - 2. Provide LC-bead (J-bead) at exposed panel edges.
 - 3. Provide control joints where indicated.
- B. Joint-Treatment Materials: ASTM C 475/C 475M.
- 1. Joint Tape: Paper unless otherwise recommended by panel manufacturer.
 - 2. Joint Compounds: Ready-mixed vinyl type for interior and exterior use as applicable.
- C. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834.
- 1. Sealants shall have a VOC content as described in Section 07 92 00.
- D. Sound-Attenuation Blankets: ASTM C 665, Type I (unfaced).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gypsum board to comply with ASTM C 840.
- 1. Isolate gypsum board assemblies from abutting structural and masonry work. Provide edge trim and acoustical sealant.
 - 2. Single-Layer Fastening Methods: Fasten gypsum panels to supports with screws.
 - 3. Multilayer Fastening Methods: Fasten base layers and face layer separately to supports with screws.
- B. Install cementitious backer units to comply with ANSI A108.11.
- C. Fire-Resistance-Rated Assemblies: Comply with requirements of listed assemblies.
- D. Finishing Gypsum Board: ASTM C 840.
- 1. At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints.
 - 2. At substrates for tile, provide Level 2 finish: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges.
 - 3. Unless otherwise indicated, provide Level 4 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.

- 4. Where indicated, provide Level 5 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges. Apply skim coat to entire surface.
- E. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.
- F. 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.

END OF SECTION 09 29 00

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Samples.
- B. Obtain tile of each type and color or finish from same production run for each contiguous area
- C. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

PART 2 - PRODUCTS

2.1 CERAMIC TILE

- A. Ceramic tile that complies with Standard grade requirements in ANSI A137.1, "Specifications for Ceramic Tile."

2.2 INSTALLATION MATERIALS

- A. Low-Emitting Materials: Adhesives shall comply with VOC limits described in Section 07 92 00.
- B. Setting and Grouting Materials: Comply with material standards in ANSI's "Specifications for the Installation of Ceramic Tile" that apply to materials and methods indicated.
 - 1. Thin-Set Mortar Type: Latex-portland cement.
 - a. Manufacturers:
 - 1) Boiardi Products; a QEP company.
 - 2) Bonsal American; an Oldcastle company.
 - 3) Bostik, Inc.
 - 4) C-Cure.
 - 5) Custom Building Products.
 - 6) Jamo Inc.
 - 7) Laticrete International, Inc.
 - 8) MAPEI Corporation.
 - 9) Southern Grouts & Mortars, Inc.
 - 10) Summitville Tiles, Inc.
 - 11) TEC; a subsidiary of H. B. Fuller Company.
 - 2. Grout Type: Standard cement, **unless otherwise indicated**.
 - a. Manufacturers:
 - 1) Boiardi Products; a QEP company.
 - 2) Bonsal American; an Oldcastle company.
 - 3) Bostik, Inc.
 - 4) C-Cure.
 - 5) Custom Building Products.
 - 6) Jamo Inc.
 - 7) Laticrete International, Inc.
 - 8) MAPEI Corporation.
 - 9) Southern Grouts & Mortars, Inc.
 - 10) Summitville Tiles, Inc.
 - 11) TEC; a subsidiary of H. B. Fuller Company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For installations indicated below, follow procedures in ANSI's "Specifications for the Installation of Ceramic Tile" for providing 95 percent mortar coverage.
 - a. Exterior tile floors.
 - b. Tile floors in wet areas.
 - c. Tile swimming pool decks.
 - d. Tile floors in laundries.
 - e. Tile floors composed of tiles 8 by 8 inches or larger.
 - f. Tile floors composed of rib-backed tiles.
- B. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- C. Lay tile in grid pattern unless otherwise indicated. Align joints where adjoining tiles on floor, base, walls, and trim are the same size.
- D. Install waterproofing to comply with ANSI A108.13.
- E. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
- F. Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-Portland cement mortar (thin set).
- G. Apply sealer to cleaned stone tile flooring according to sealer manufacturer's written instructions.
- H. Interior Floor Tile Installation Method(s):
 - 1. Over Concrete Subfloors: TCA F113 (thin-set mortar)
- I. Interior Wall Tile Installation Method(s):
 - 1. Over Cement Board: TCA W244C

END OF SECTION 09 30 00

SECTION 09 65 00 - RESILIENT FLOORING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Samples.
- B. Extra Materials:
 - 1. Resilient Floor Tile: Deliver to Owner one box for every **50** boxes or fraction thereof, of each type and color of resilient floor tile installed.

PART 2 - PRODUCTS

2.1 VINYL PLANK FLOORING

- A. Products: Basis-of-design product is Armstrong, Natural Personality

2.2 VINYL COMPOSITION FLOOR TILE

- A. Products: Basis-of-design product is Armstrong, Standard Excelon

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement- or blended hydraulic cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- B. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
- C. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.
 - 1. Low-Emitting Materials: Adhesives and sealants shall comply with the South Coast Air Quality Management District Rule #1168. Acceptable VOC limits are listed in the table provided at: www.arb.ca.gov/DRDB/SC/CURHTML/R1168.pdf.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare concrete substrates according to ASTM F 710. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
- B. Maintain uniformity of resilient sheet flooring direction, and match edges for color shading at seams.
- C. Lay out tiles so tile widths at opposite edges of room are equal and are at least one-half of a tile.

- D. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged. Lay tiles with grain running in one direction or in patterns indicated.
- E. Install reducer strips at edges of floor coverings that would otherwise be exposed.
- F. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.
 - 1. Apply one coat(s).

END OF SECTION 09 65 00

SECTION 09 68 00 - CARPETING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Samples.
- B. Extra Materials: Full-size units (modular) and full-width (broadloom) carpet equal to 5 percent of each type and color installed, packaged with protective covering for storage.

PART 2 - PRODUCTS

2.1 CARPET

- A. Manufacturers:
 - 1. Shaw
 - 2. Mohawk
 - 3. J&J Industries
- B. Fiber Content: Refer to Drawings
- C. Pile Characteristic: Refer to Drawings
- D. Total Weight: Refer to Drawings.
- E. Primary Backing: Refer to Drawings
- F. Width: 12 feet (Broadloom) or Modular; Refer to Drawings
- G. Appearance Retention Rating: Moderate traffic, 2.5 minimum per ASTM D 7330.
- H. Emissions: Provide carpet that complies with testing and product requirements of CRI's "Green Label Plus" program.

2.2 CARPET CUSHION

- A. Polyurethane Foam Cushion: recycled content foam.
 - 1. Thickness: 7/16"
 - 2. Density: 6 lb min.
- B. Emissions: Provide carpet cushion that complies with testing and product requirements of CRI's "Green Label" program.

2.3 INSTALLATION ACCESSORIES

- A. Cushion Adhesives: Product that complies with flammability requirements for installed carpet and is recommended by carpet cushion manufacturers for conditions indicated.
 - 1. Low-Emitting Materials: Adhesives and sealants shall comply with the South Coast Air Quality Management District Rule #1168. Acceptable VOC limits are listed in the table provided at: www.arb.ca.gov/DRDB/SC/CURHTML/R1168.pdf.
- B. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Drawings for location, type and carpet materials.
- B. Comply with CRI 104.
- C. Carpet Installation Method:
 - 1. Broadloom:
 - a. Maintain uniformity of carpet direction and lay of pile. At doorways, center seams under door in closed position. Bind or seal cut edges as recommended by carpet manufacturer.
 - b. Install pattern parallel to walls and borders, unless noted otherwise on the Drawings.
 - 2. Modular:
 - a. Refer to Drawings for carpet direction and pattern.
 - b. Install according to manufacturer's recommendations.

END OF SECTION 09 68 00

SECTION 09 90 00 - PAINTING AND COATING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data.
 - 2. Samples.
- B. Mockups: Full-coat finish Sample of each type of coating, color, and substrate, applied where directed.
- C. Extra Materials: Deliver to Owner 5 gallons of each color and type of finish coat paint used on Project, in containers, properly labeled and sealed.

PART 2 - PRODUCTS

2.1 PAINT

- A. Manufacturers:
 - 1. Behr Process Corporation.
 - 2. Benjamin Moore & Co.
 - 3. Benjamin Moore & Co. (Canada).
 - 4. Bennette Paint Manufacturing Company, Inc.
 - 5. Betonel Ltd.
 - 6. BLP Mobile Paint Manufacturing.
 - 7. California Paints.
 - 8. Cloverdale Paint.
 - 9. Color Wheel Paints & Coatings.
 - 10. Columbia Paint & Coatings.
 - 11. Conco Paints.
 - 12. Coronado Paint.
 - 13. Davis Paint Company.
 - 14. Del Technical Coatings.
 - 15. Diamond Vogel Paints.
 - 16. Dunn-Edwards Corporation.
 - 17. Durant Performance Coatings.
 - 18. Duron, Inc.
 - 19. Envirocoatings Canada Inc.
 - 20. Euclid Chemical Company.
 - 21. Farrell-Calhoun.
 - 22. Frazee Paint.
 - 23. General Paint.
 - 24. Hallman Lindsay Paints.
 - 25. Hirshfield's, Inc.
 - 26. ICI Paints.
 - 27. ICI Paints (Canada).
 - 28. Insl-x.
 - 29. Kelly-Moore Paints.
 - 30. Kwal Paint.
 - 31. Life Paint Corp.
 - 32. M.A.B. Paints.
 - 33. McCormick Paints.

34. Microblend Technologies Inc.
35. Miller Paint.
36. Mills Paint.
37. PARA Paints.
38. Parex LaHabra Inc.
39. Parker Paint Mfg. Co. Inc.
40. PPG Architectural Finishes, Inc.
41. Pratt & Lambert.
42. Rodda Paint Co.
43. SaverSystems.
44. Scott Paint.
45. Sherwin-Williams Company (The).
46. Sico, Inc.
47. Southern Diversified Products, LLC.
48. Smith Paint Products.
49. Vista Paint.
50. Zinsser.

B. MPI Standards: Provide materials that comply with MPI standards indicated and listed in its "MPI Approved Products List."

1. Exterior Painting Materials:
 - a. Block Filler, Latex: MPI #4.
 - b. Primer, Alkali Resistant, Water Based: MPI #3.
 - c. Primer, Bonding, Water Based: MPI #17.
 - d. Primer, Bonding, Solvent Based: MPI #69.
 - e. Primer, Alkyd, Anticorrosive: MPI #79.
 - f. Primer, Galvanized, Water Based: MPI #134.
 - g. Primer, Quick Dry, for Aluminum: MPI #95.
 - h. Primer, Latex: MPI #6.
 - i. Primer, Alkyd: MPI #5.
 - j. Latex, Exterior Flat (Gloss Level 1): MPI #10.
 - k. Latex, Exterior Low Sheen (Gloss Level 3-4): MPI #15.
 - l. Latex, Exterior Semigloss (Gloss Level 5): MPI #11.
 - m. Latex, Exterior, Gloss (Gloss Level 6): MPI #119.
 - n. Light Industrial Coating, Exterior, Water Based (Gloss Level 3): MPI #161.
 - o. Light Industrial Coating, Exterior, Water Based, Semigloss (Gloss Level 5): MPI #163.
 - p. Light Industrial Coating, Exterior, Water Based, Gloss (Gloss Level 6): MPI #164.
 - q. Alkyd, Exterior Flat (Gloss Level 1): MPI #8.
 - r. Alkyd, Exterior, Semigloss (Gloss Level 5): MPI #94.
 - s. Alkyd, Exterior Gloss (Gloss Level 6): MPI #9.
 - t. Alkyd, Quick Dry, Semigloss (Gloss Level 5): MPI #81.
 - u. Alkyd, Quick Dry, Gloss (Gloss Level 7): MPI #96.
 - v. Floor Paint, Latex, Low Gloss (Maximum Gloss Level 3): MPI #60.
 - w. Floor Enamel, Alkyd, Gloss (Gloss Level 6): MPI #27.
2. Interior Painting Materials:
 - a. Block Filler, Latex: MPI #4.
 - b. Primer Sealer, Latex: MPI #50.
 - c. Primer, Alkali Resistant, Water Based: MPI #3.
 - d. Primer Sealer, Institutional Low Odor/VOC: MPI #149.
 - e. Primer, Latex, for Interior Wood: MPI #39.
 - f. Primer Sealer, Alkyd, Interior: MPI #45.
 - g. Primer, Bonding, Water Based: MPI #17.
 - h. Primer, Bonding, Solvent Based: MPI #69.
 - i. Primer, Alkyd, Anticorrosive: MPI #79.
 - j. Primer, Galvanized, Water Based: MPI #134.

- k. Primer, Quick Dry, for Aluminum: MPI #95.
 - l. Latex, Interior, Flat, (Gloss Level 1): MPI #53.
 - m. Latex, Interior, (Gloss Level 2): MPI #44.
 - n. Latex, Interior, (Gloss Level 4): MPI #43.
 - o. Latex, Interior, Semigloss, (Gloss Level 5): MPI #54.
 - p. Latex, Interior, Gloss, (Gloss Level 6, except Minimum Gloss of 65 Units at 60 Degrees): MPI #114.
 - q. Latex, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.
 - r. Latex, Institutional Low Odor/VOC, (Gloss Level 2): MPI #144.
 - s. Latex, Institutional Low Odor/VOC, Semigloss (Gloss Level 5): MPI #147.
 - t. Latex, High Performance Architectural, (Gloss Level 2): MPI #138.
 - u. Latex, High Performance Architectural, Semigloss (Gloss Level 5): MPI #141.
 - v. Alkyd, Interior, Flat (Gloss Level 1): MPI #49.
 - w. Alkyd, Interior, Semigloss (Gloss Level 5): MPI #47.
 - x. Alkyd, Interior, Gloss (Gloss Level 6): MPI #48.
 - y. Alkyd, Quick Dry, Semigloss (Gloss Level 5): MPI #81.
 - z. Alkyd, Quick Dry, Gloss (Gloss Level 7): MPI #96.
 - aa. Floor Paint, Latex, Low Gloss (Maximum Gloss Level 3): MPI #60.
 - bb. Floor Enamel, Alkyd, Gloss (Gloss Level 6): MPI #27.
3. Staining and Clear Finishing Materials:
- a. Wood Filler Paste: MPI #91.
 - b. Primer, Latex for Exterior Wood: MPI #6.
 - c. Primer, Alkyd for Exterior Wood: MPI #5.
 - d. Primer, Oil for Exterior Wood: MPI #7.
 - e. Preservative, for Exterior Wood: MPI #37.
 - f. Alkyd, Sanding Sealer, Clear: MPI #102.
 - g. Shellac: MPI #88.
 - h. Stain, Exterior, Water Based, Solid Hide: MPI #16.
 - i. Stain, Exterior, Solvent Based, Solid Hide: MPI #14.
 - j. Stain, Exterior, Solvent Based, Semitransparent: MPI #13.
 - k. Stain, for Exterior Wood Decks: MPI #33.
 - l. Stain, Semitransparent, for Interior Wood: MPI #90.
 - m. Varnish, Water Based, Clear, Satin (Gloss Level 4): MPI #128.
 - n. Varnish, Water Based, Clear, Semigloss (Gloss Level 5): MPI #129.
 - o. Varnish, Water Based, Clear, Gloss (Gloss Level 6): MPI #130.
 - p. Varnish, with UV Inhibitor, Exterior, Semigloss (Gloss Level 5): MPI #30.
 - q. Varnish, with UV Inhibitor, Exterior, Gloss (Gloss Level 6): MPI #29.
 - r. Varnish, Marine Spar, Exterior, Gloss (Gloss Level 7): MPI #28.
 - s. Varnish, Interior, Flat (Gloss Level 1): MPI #73.
 - t. Varnish, Interior, Semigloss (Gloss Level 5): MPI #74.
 - u. Varnish, Interior, Gloss (Gloss Level 6): MPI #75.
 - v. Varnish, Interior, Polyurethane, Oil-Modified, Satin (Gloss Level 4): MPI #57.
 - w. Varnish, Interior, Polyurethane, Oil-Modified, Gloss (Gloss Level 6): MPI #56.
 - x. Varnish, Polyurethane, Moisture-Cured, Gloss (Gloss Level 6): MPI #31.
 - y. Varnish, Aliphatic Polyurethane, Two-Component (Gloss Level 6 or 7): MPI #78.
 - z. Danish Oil: MPI #92.
4. High-Performance Coating Materials:
- a. Block Filler, Latex: MPI #4.
 - b. Block Filler, Epoxy: MPI #116.
 - c. Primer Sealer, Latex: MPI #50.
 - d. Primer, Zinc-Rich, Epoxy: MPI #20.
 - e. Primer, Epoxy, Anticorrosive: MPI #101.
 - f. Epoxy, Gloss: MPI #77.
 - g. Epoxy-Modified Latex, Gloss (Gloss Level 6): MPI #115.
 - h. Epoxy Deck Coating (Slip Resistant): MPI #82.
 - i. Polyurethane, Two-Component, Pigmented, Gloss (Gloss Level 6): MPI #72.

- C. Material Compatibility: Provide materials that are compatible with one another and with substrates.
 - 1. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- D. Use interior paints and coatings that comply with VOC limits of the Green Seal Environmental Standard GS-11.
- E. Colors: As selected

2.2 COATINGS

- A. Low-Emitting Materials: All coatings used on the interior of the building shall comply with South Coast Air Quality Management District Rule #1113. Acceptable volatile organic compound (VOC) limits are listed in the table provided at the following web address:
<http://www.arb.ca.gov/DRDB/SC/CURHTML/R1113.PDF>.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, lighting fixtures, and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete.
- C. Clean and prepare surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.

3.2 APPLICATION

- A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Paint exposed surfaces unless otherwise indicated.
 - 1. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.
 - 2. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint the back side of access panels.
 - 4. Color-code mechanical piping in accessible ceiling spaces.
 - 5. Do not paint prefinished items, items with an integral finish, operating parts, and labels unless otherwise indicated.
- C. Apply paints according to manufacturer's written instructions.
 - 1. Use brushes only for exterior painting and where the use of other applicators is not practical.
 - 2. Use rollers for finish coat on interior walls and ceilings.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 - 1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

- E. Apply stains and transparent finishes to produce surface films without color irregularity, cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other imperfections. Use multiple coats to produce a smooth surface film of even luster.

3.3 EXTERIOR PAINT APPLICATION SCHEDULE

- A. Galvanized Metal:
 - 1. Semigloss Latex: Two coats over waterborne galvanized-metal primer: MPI EXT 5.3H.
- B. Wood: Including wood trim
 - 1. Semigloss Latex: Two coats over latex primer: MPI EXT 6.3L.
- C. Exterior Gypsum Soffit Board:
 - 1. Flat Latex: Two coats: MPI EXT 9.2A.

3.4 INTERIOR PAINT APPLICATION SCHEDULE

- A. Galvanized Metal:
 - 1. Semigloss Latex: Two coats over waterborne galvanized-metal primer: MPI INT 5.3J.
- B. Wood: Including wood trim
 - 1. Semigloss Latex: Two coats over latex primer for wood: MPI INT 6.3T.
- C. Gypsum Board
 - 1. Flat Latex: Two coats over latex primer/sealer: MPI INT 9.2A.
- D. Spray-Textured Ceilings:
 - 1. Flat Latex: One coat over primer/sealer: MPI INT 9.1A

END OF SECTION 09 90 00

SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, Shop Drawings, and Samples.
 - 1. Submit full-size rubbings for metal plaques.

PART 2 - PRODUCTS

2.1 SIGNS, GENERAL

- A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

2.2 SIGNS – DESCRIPTIONS

- A. Entrance Sign – (2) 12.5 SF High Density Urethane (HDU) panels, installed on block/stone veneer wall over concrete footing. Logo/design by others.
- B. Parking signs – 12" x 16" x 1/2" PVC panels. Post mounted.
 - 1. "Handicap Parking" – at each HC spot indicated on drawings.
 - 2. "Van Accessible" – as indicated
 - 3. Visitor parking – provide at parking area adjacent to Leasing Offices
- C. Leasing Center Hours – 16"x16"x1/2" PVC panel. Wall mounted.
- D. Pool Rules – 30"x55"x1/2" PVC. Fence mounted.
- E. Emergency Phone – 12"x12"x1/2" PVC. Wall mounted.
- F. Fitness Center Rules – 16"x24"x1/2" PVC. Wall mounted.
- G. Interior Door ID signs (common areas) – 8"x8"x1/8" PVC. Wall mounted.
- H. Exterior Door ID signs (at entrance doors) - 12"x6"x1/2" PVC. Wall mounted.
- I. Unit number signs – 6"x3"x3/16" acrylic. Door mounted.
- J. FDC signs – 16"x10"x1/2". Red aluminum w/ white lettering. One per building, wall mounted.
- K. Fire Sprinkler Door ID -2 1/2"x12" x 1/16". One per building.

END OF SECTION 10 14 00

SECTION 10 28 00 – TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 TOILET AND BATH ACCESSORIES

- A. Manufacturers:
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 - 6. Tubular Specialties Manufacturing, Inc.
- B. Paper Towel Dispenser
 - 1. Basis-of-Design Product: American Specialties Inc.; ASI-0462-AD-9
 - 2. Mounting: Recessed
 - 3. Material: Stainless steel, No. 4 finish (satin)
 - 4. Lockset: Tumbler type.
 - 5. Refill Indicators: Pierced slots at sides or front.
- C. Toilet Tissue Dispenser
 - 1. Basis-of-Design Product: American Specialties Inc.; ASI-0030
 - 2. Type: Double-roll dispenser.
 - 3. Mounting: Surface mounted with concealed anchorage
 - 4. Material: Stainless steel
- D. Waste Receptacle
 - 1. Basis-of-Design Product: American Specialties Inc.; ASI-0462-AD-9
 - 2. Mounting: Recessed
 - 3. Material: Stainless steel, No. 4 finish (satin)
 - 4. Lockset: Tumbler type.
 - 5. Refill Indicators: Pierced slots at sides or front.
- E. Liquid-Soap Dispenser
 - 1. Basis-of-Design Product: American Specialties Inc.; ASI-0345
 - 2. Mounting: Surface.
 - 3. Materials: Stainless Steel
 - 4. Stainless-Steel Soap Valve: Designed for dispensing soap in liquid form.
 - 5. Lockset: Tumbler type.
 - 6. Refill Indicator: Window type.
- F. Grab Bar
 - 1. Material: Stainless steel, 0.050 inch thick.
 - 2. Mounting: Concealed
 - 3. Gripping Surfaces: Slip-resistant texture.
 - 4. Outside Diameter: 1-1/2 inches for heavy-duty applications.

- G. Shower Curtain Rod (dwelling units)
 - 1. Basis-of-Design Product: Pamex, Model BSR-573, 673
 - 2. Description: 1" diameter curved shower rod
 - 3. Mounting: Flanges with exposed fasteners.
 - 4. Length: 60-61" (5' model)
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin)
- H. Towel Bar and Towel Ring (dwelling units)
 - 1. Basis-of-Design Product: Better Home Products (BHP); Union Square IV
 - 2. Description: 18" and 24" towel bars and towel ring
 - 3. Mounting: Flanges with concealed fasteners.
 - 4. Material and Finish: Stainless steel, No. 4 finish (satin)
- I. Under-lavatory Guard
 - 1. Description: Insulating pipe coverings for supply and drain piping assemblies, which prevent direct contact with and burns from piping, and allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded plastic, white.
- J. Utility Shelf with Mop Holder.
 - 1. Basis of Design: American Specialties Model No. 1315-4; 36 inches long
 - 2. Description: Utility shelf with Mop Holders (4), Drying Rod and Rag Hooks (3) fabricated from 18-gauge alloy 18-8 stainless steel, type 304. Shelf to have 2 1/2" wide hemmed-in edge all around. Provide rubber-cam mop-holders at the face. Mop holders to be fabricated of cadmium plated steel. Drying rod to be 3/8" diameter stainless steel. Mounting brackets to be 16 gauge.
 - 3. Material and Finish: Exposed surfaces to be No. 4 satin finish.
- K. Channel Frame Mirrors
 - 1. Basis of Design: American Specialties Model 0620,
 - 2. Frame: 18-8, type 304, 20-gauge stainless steel roll-formed one-piece construction, No. 4 satin finish.
 - 3. Glass: No. 1 quality, 1/4" thick plate/float, silver coated and hermetically sealed with a uniform copper plating.
 - a. Glass to comply with ASTM C-1503 and ASTM C-1036-91.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.0312-inch minimum nominal thickness unless otherwise indicated.
- B. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- C. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.
- D. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of 4 keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
 - 1. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.
- B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

END OF SECTION 10 28 00

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS, BRACKETS, AND CABINETS

- A. Portable Fire Extinguishers: NFPA 10, listed and labeled for the type, rating, and classification of extinguisher.
 - 1. Manufacturers:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - h. Larsen's Manufacturing Company.
 - i. Moon-American.
 - j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
 - k. Potter Roemer LLC.
 - l. Pyro-Chem; Tyco Safety Products.
 - 2. Multipurpose Dry-Chemical Type: UL-rated 1-A:10-B:C, 2.5-lb nominal capacity, in enameled-steel container.
- B. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for fire extinguishers indicated, with plated or baked-enamel finish.
- C. Recessed wall cabinet, with vertical duo style door with clear acrylic glazing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install 2.5 lb. fire extinguishers in sink base cabinets in dwelling units.
- B. Install 10 lb. fire extinguisher in rated recessed wall cabinet at locations indicated on Life Safety Plans.
- C. Install semi-recessed fire extinguisher cabinets on each floor of each breezeway and corridors, in location indicated on plans.

END OF SECTION 10 44 00

SECTION 10 55 20 - MAILBOXES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data
- B. Verify dimensions by field measurements before ordering

1.2 REFERENCES

- A. United States Postal Service Standard 4C, Wall-Mounted Centralized Mail Receptacles.
- B. Americans with Disabilities Act Accessibility Guidelines (ADAAG).
- C. Fair Housing Act Design Guidelines

PART 2 - PRODUCTS

2.1 FRONT-LOADING MAILBOXES

- A. Manufacturers:
 - 1. Basis of Design: AF Florence Manufacturing Co.
- B. USPS Approved front-loading mailboxes: Horizontal style, complying with USPS STD 4C and the following:
 - 1. Model: Series 4C by AF Florence Manufacturing
 - a. Actual configuration to be determined
 - 2. Mounting: Recessed mounted.
 - 3. Locks: USPS-1172 910A, 3 keys each lock.
 - 4. Box identification: Top to bottom, left to right.
 - 5. Numerical order
- C. Material and Finish: Aluminum with powder coat finish
 - 1. Finish selected from manufacturer's standard colors.

PART 3 - EXECUTION

- A. Verify that openings in wall are correctly located, aligned, and sized for mailboxes.
- B. Install mail boxes in accordance with shop drawings and manufacturer's printed installation instructions.
- C. Align, plumb, and level; anchor in accordance with manufacturer's requirements.

END OF SECTION 10 55 20

SECTION 10 57 23 - CLOSET AND UTILITY SHELVING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data
- B. Verify dimensions by field measurements before ordering

PART 2 - PRODUCTS

2.1 WIRE CLOSET SHELVING

- A. Manufacturers:
 - 1. Closetmaid Corporation.
 - 2. Rubbermaid.
 - 3. Schulte Corporation.
 - 4. Spacetek
- B. Wire closet shelving, made from steel wire spaced not more than 1 inch o.c. and welded to longitudinal steel wire rods. Provide longitudinal wire rods at shelf edges and corners of lips, with not less than four longitudinal wire rods per shelf. Provide shelves of widths indicated. Provides units complete with brackets, fasteners, end caps, and accessories indicated.
 - 1. Provide fixed (nonadjustable) units of configurations and in quantities and sizes indicated.
 - 2. Provide units with rod for clothes hangers in bedroom closets.

2.2 MATERIALS

- A. Steel Wire: ASTM A 853.

2.3 FINISHES

- A. Wire Shelving Finish: White epoxy/polyester or vinyl applied over cleaned and conversion-coated metal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units in configurations indicated, complete with accessories indicated, and ready for use.
- B. Install units level, plumb, and true to line, without warp or rack and anchor securely in place.
- C. Repair, refinish, or replace wire closet shelving damaged during installation, as directed by Architect.

END OF SECTION 10 57 23

SECTION 11 31 00 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 RESIDENTIAL APPLIANCES

- A. Regulatory Requirements: Comply with the following:
1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.
- B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with ICC A117.1.
- C. Electric Range: 30-inch-wide, freestanding range with 4 burners and self-cleaning oven with broiler unit.
1. Basis-of-Design Product: General Electric, Model; JBS15MBB, or a comparable product of one of the following:
 - a. Amana; a division of Whirlpool Corporation.
 - b. BOSCH Home Appliances.
 - c. BSH Home Appliances Corporation (Thermador).
 - d. Dacor, Inc.
 - e. Dynamic Cooking Systems, Inc.; a subsidiary of Fisher & Paykel Appliances Holdings Limited.
 - f. Electrolux Home Products (Frigidaire).
 - g. Fisher & Paykel.
 - h. General Electric Company (GE).
 - i. General Electric Company (Hotpoint).
 - j. Jade Home Products Company.
 - k. Jenn-Air; a division of Whirlpool Corporation.
 - l. KitchenAid; a division of Whirlpool Corporation.
 - m. LG Appliances.
 - n. Maytag; a division of Whirlpool Corporation.
 - o. Samsung.
 - p. Sears Brands LLC (Kenmore).
 - q. Sharp Electronics Corp.
 - r. Viking Range Corporation.
 - s. Whirlpool Corporation.
 - t. Wolf Appliance, Inc.
 2. Color: Black
 3. ADA compliant: Provide ADA compliant appliances in units identified to be ADA.
- D. Microwave Oven: Under-cabinet/over-the-range microwave oven, with ventilating exhaust hood.
1. Basis-of-Design Product: JNM1541DNBB, or a comparable product of one of the following:
 - a. Amana; a division of Whirlpool Corporation.
 - b. BOSCH Home Appliances.

- c. BSH Home Appliances Corporation (Gaggenau).
 - d. BSH Home Appliances Corporation (Thermador).
 - e. Dacor, Inc.
 - f. Dynamic Cooking Systems, Inc.; a subsidiary of Fisher & Paykel Appliances Holdings Limited.
 - g. Electrolux Home Products (Frigidaire).
 - h. General Electric Company (GE).
 - i. General Electric Company (Hotpoint).
 - j. Jenn-Air; a division of Whirlpool Corporation.
 - k. KitchenAid; a division of Whirlpool Corporation.
 - l. LG Appliances.
 - m. Maytag; a division of Whirlpool Corporation.
 - n. Samsung.
 - o. Sears Brands LLC (Kenmore).
 - p. Sharp Electronics Corp.
 - q. Viking Range Corporation.
 - r. Whirlpool Corporation.
 - s. Wolf Appliance, Inc.
 2. Color: Black
 3. ADA Compliant: Where required provide counter-top microwave model similar to models above.
- E. Exhaust Hood: 30-inch undercabinet-mounted, ventilating exhaust hood with variable-speed fan, installed in accessible units only.
1. Manufacturers:
 - a. BOSCH Home Appliances.
 - b. BSH Home Appliances Corporation (Gaggenau).
 - c. BSH Home Appliances Corporation (Thermador).
 - d. Dacor, Inc.
 - e. Dynamic Cooking Systems, Inc.; a subsidiary of Fisher & Paykel Appliances Holdings Limited.
 - f. Electrolux Home Products (Frigidaire).
 - g. Fisher & Paykel.
 - h. General Electric Company (GE).
 - i. General Electric Company (Hotpoint).
 - j. Jenn-Air; a division of Whirlpool Corporation.
 - k. KitchenAid; a division of Whirlpool Corporation.
 - l. Maytag; a division of Whirlpool Corporation.
 - m. Miele, Inc.
 - n. Sears Brands LLC (Kenmore).
 - o. Sharp Electronics Corp.
 - p. Viking Range Corporation.
 - q. Whirlpool Corporation.
 - r. Wolf Appliance, Inc.
 2. Color: Black
 3. Fan Control: Hood and Wall-mounted switch, with separate light switch.
- F. Refrigerator/Freezer: Freestanding, "Frost-Free", two-door refrigerator with top-mounted freezer
1. Basis-of-Design Product: GE; Model GTH18IBD, or a comparable product of one of the following:
 - a. Amana; a division of Whirlpool Corporation.
 - b. BOSCH Home Appliances.
 - c. BSH Home Appliances Corporation (Gaggenau).
 - d. BSH Home Appliances Corporation (Thermador).
 - e. Dacor, Inc.

- f. Electrolux Home Products (Frigidaire).
 - g. Fisher & Paykel.
 - h. General Electric Company (GE).
 - i. General Electric Company (Hotpoint).
 - j. Jenn-Air; a division of Whirlpool Corporation.
 - k. KitchenAid; a division of Whirlpool Corporation.
 - l. LG Appliances.
 - m. Maytag; a division of Whirlpool Corporation.
 - n. Samsung.
 - o. Sears Brands LLC (Kenmore).
 - p. Sub-Zero, Inc.
 - q. Viking Range Corporation.
 - r. Whirlpool Corporation.
 - 2. Color: Black
 - 3. Options: Ice-maker included
 - 4. Energy Performance: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
 - 5. Provide ADA-compliant model where required.
- G. Dishwasher: Built-in, undercounter, automatic dishwasher, sized to replace 24-inch-base cabinet.
- 1. Basis-of-Design Product: GE; Model GSD4000DBB or a comparable product of one of the following:
 - a. Amana; a division of Whirlpool Corporation.
 - b. ASKO North America; a division of AM Appliance Group.
 - c. BOSCH Home Appliances.
 - d. BSH Home Appliances Corporation (Gaggenau).
 - e. BSH Home Appliances Corporation (Thermador).
 - f. Dacor, Inc.
 - g. Dynamic Cooking Systems, Inc.; a subsidiary of Fisher & Paykel Appliances Holdings Limited.
 - h. Electrolux Home Products (Frigidaire).
 - i. Fisher & Paykel.
 - j. General Electric Company (GE).
 - k. General Electric Company (Hotpoint).
 - l. Jenn-Air; a division of Whirlpool Corporation.
 - m. KitchenAid; a division of Whirlpool Corporation.
 - n. LG Appliances.
 - o. Maytag; a division of Whirlpool Corporation.
 - p. Miele, Inc.
 - q. Sears Brands LLC (Kenmore).
 - r. Viking Range Corporation.
 - s. Whirlpool Corporation.
 - 2. Color: Black
 - 3. Options: ADA compliant where required.
 - 4. Energy Performance: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Built-in Appliances: Securely anchor to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

- B. Freestanding Appliances: Place in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- C. Test each item of residential appliances to verify proper operation. Make necessary adjustments.
- D. Verify that accessories required have been furnished and installed.

END OF SECTION 11 31 00

SECTION 11 68 00 - PLAYGROUND EQUIPMENT AND STRUCTURES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, Shop Drawings, and color Samples.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Safety Standards: ASTM F 1487

2.2 PLAYGROUND EQUIPMENT FABRICATION

- A. Metal Frame: Fabricate main-frame upright support posts from metal pipe or tubing. Fabricate secondary frame members, bracing, and connections from either steel or aluminum.
- B. Play Surfaces: Provide manufacturer's standard play surfaces, designed to withstand loads; fabricated from wood mulch with slip-resistant foot surfaces.
- C. Protective Barriers and Guardrails: Fabricate according to ASTM F 1487 and CPSC No. 325

2.3 PLAYGROUND EQUIPMENT AND STRUCTURES

- A. Swings:
 - 1. Manufacturers:
 - a. American Swing Products Inc.
 - b. BCI Burke Company, LLC.
 - c. Big Toys, Inc.
 - d. Blue Imp.
 - e. Columbia Cascade Company.
 - f. GameTime; a PlayCore company.
 - g. Henderson Recreation Equipment Ltd.
 - h. Kidstuff Playsystems, Inc.
 - i. Kompan, Inc.
 - j. Krauss Craft, Inc.
 - k. Landscape Structures Inc.
 - l. L. A. Steelcraft Products, Inc.
 - m. Little Tikes Commercial, Inc; Playpower LT Farmington, Inc.
 - n. Miracle Recreation Equipment Co.; a division of PlayPower, Inc.
 - o. Play & Park Structures; a PlayCore company.
 - p. Playland International, LLC; a division of Superior International Industries, Inc.
 - q. Playworld Systems, Inc.
 - r. PlayTown; a division of SportsPlay Equipment Inc.
 - s. Recreation Creations, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Anchor playground equipment securely, positioned at locations and elevations indicated.

- B. Post and Footing Excavation: Excavate holes for posts and footings as indicated in firm, undisturbed or compacted subgrade soil.
- C. Post Set with Concrete Footing: Comply with ACI 301.
 - 1. Set equipment posts in concrete footing. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at the correct angle, alignment, height, and spacing.
 - 2. Concrete Footings: Smooth top, and shape to shed water.

END OF SECTION 11 68 00

SECTION 12 21 00 - WINDOW BLINDS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Samples.

PART 2 - PRODUCTS

2.1 WINDOW BLINDS

- A. Manufacturers:
 - 1. Hunter Douglas Contract.
 - 2. Levolor Contract; a Newell Rubbermaid company.
 - 3. Springs Window Fashions.
- B. Provide blinds passing flame-resistance testing according to NFPA 701.
- C. Fabrication: Comply with WCMA A 100.1 unless otherwise indicated.
 - 1. Provide color-coated finish on exposed metal parts unless otherwise indicated.
 - 2. Fabricate concealed components from noncorrodible or corrosion-resistant-coated materials.
 - 3. Provide permanently lubricated moving parts.

2.2 HORIZONTAL BLIND

- A. Slats: Extruded PVC (vinyl), UV-stabilized and integrally colored.
- B. Slat Width: 2 inches
- C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends.
- D. Tilt Operation: Manual with cord.
- E. Valance: Manufacturer's standard.
- F. Mounting: Ceiling.
- G. Colors, Textures, Patterns, and Gloss: As selected from manufacturer's standard options

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install blinds level, plumb, and located not closer than 1 inch to interior face of glass.
 - 1. Jamb Mounted: Install headrail flush with face of opening jamb and head.
 - 2. Head Mounted: Install headrail on face of opening head.
- B. Adjust window blinds to operate smoothly and easily throughout entire operational range.

END OF SECTION 12 21 00

SECTION 12 35 30 - RESIDENTIAL CASEWORK

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Shop Drawings.

PART 2 - PRODUCTS

2.1 CABINETS

- A. Comply with KCMA A161.1.
 - 1. Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semi-exposed location of each unit.
- B. Kitchen and Vanity Cabinets:
 - 1. Basis of Design Product: Saco Industries; "Madison" (Shaker) style, or a comparable product of one of the following:
 - a. Leedo Cabinetry
 - b. Republic Industries
 - 2. Face Style: Partial overlay
 - 3. Cabinet Style: Face frame
 - 4. Door and Drawer Fronts: Wood stiles and rails, with flat wood center panels.
 - 5. Face Frame Finish: Wood.
 - 6. Exposed Cabinet End Finish: Wood.
 - 7. Exposed Wood: Manufacturer's standard domestic hardwood species clear solid wood or hardwood plywood with Grade A faces per HPVA HP-1, selected for compatible color and grain.
 - 8. Semi-exposed Materials: Medium-density particleboard, with wood-grain, vinyl surface.
 - 9. Door and Drawer Pulls: Wire pulls and Back-mounted Knobs.
 - 10. Hinges: Fully-concealed
 - 11. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides with nylon-tired, ball-bearing rollers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cabinets with no variations in flushness of adjoining surfaces by using concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match casework face.
- B. Install cabinets without distortion so doors and drawers fit openings properly and are aligned.
- C. Install level and plumb to a tolerance of 1/8 inch in 8 feet.
- D. Fasten each cabinet to adjacent unit and to structural members of wall construction. Fasten wall cabinets through back, near top and bottom, at ends and not less than 24 inches o.c.
 - 1. Use No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.
 - 2. Use toggle bolts through metal backing behind gypsum board.

END OF SECTION 12 35 30

SECTION 12 36 23 - PLASTIC LAMINATE COUNTERTOPS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Shop Drawings.
- B. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program
- C. Installer Qualifications: Fabricator of products.
- D. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is completed, and HVAC system is operating.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: AWI, AWMAC, and WI's "Architectural Woodwork Standards."
- B. Plastic-Laminate Countertops: Economy grade.
 - 1. Laminate Grade: HGS for flat countertops, HGP for post-formed countertops.
 - 2. Grain Direction: Parallel to cabinet fronts.
 - 3. Edge Treatment: Same as laminate cladding on horizontal surfaces.

2.2 MATERIALS

- A. High-Pressure Decorative Laminate: NEMA LD 3.
 - 1. Manufacturers:
 - a. Abet Laminati, Inc.
 - b. Formica Corporation.
 - c. Lamin-Art, Inc.
 - d. Panolam Industries International, Inc.
 - e. Wilsonart International; Div. of Premark International, Inc.

2.3 FABRICATION

- A. Complete fabrication 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- B. Install countertops to comply with referenced quality standard for grade specified.
- C. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

- D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor countertops securely to base units. Seal space between backsplash and wall.

END OF SECTION 12 36 23

SECTION 12 93 00 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Samples.

PART 2 - PRODUCTS

2.1 SITE FURNISHINGS

- A. All items to be vinyl or plastic-coated, heavy-gauge steel, in color selected by architect
- B. Benches – 6' w/ back. (2) total
- C. Picnic tables – 46" square, round or octagonal. (5) total, with (1) ADA-compliant model.
- D. 20" Campfire grills – With adjustable grate. (5) total.
- E. 32 gal. trash receptacles with flat-top lids. (5) total

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Anchor site furnishings securely, positioned at locations and elevations indicated.
- B. Post Setting: Set cast-in support posts in concrete footing.
- C. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete and fill annular space between post and concrete with grout.
- D. Pipe Sleeves: Use steel pipe sleeves anchored into concrete for installing posts. After posts have been inserted, fill annular space between post and sleeve with grout.

END OF SECTION 12 93 00

SECTION 13 11 13 – IN-GROUND SWIMMING POOLS

PART 1 - DESCRIPTION

Pool for this project shall be a site-fabricated in-ground pool, constructed of engineered, steel-reinforced monolithic gunnite, pre-cast coping and reinforced concrete deck with decorative finish. Pool area shall be between 1000-1500 sq. ft., and have a maximum depth of 5'. Pool shall include adequate low-voltage underwater lighting and stainless steel handrails and/or ladders. Recirculation pump and sand filter system shall be sized per manufacturer's recommendations, and all required safety and maintenance equipment shall be included.

Fencing, gates and signage shall be installed per local requirements.

END OF SECTION 13 11 13

SECTION 14 56 00 - CHUTES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes metal, vertical, gravity-type waste chutes.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Detail chute assemblies and indicate installation details, dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Provide chutes complying with NFPA 82.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cutler Manufacturing Corporation.
 - 2. Midland Metalcraft Co.
 - 3. U.S. Chutes Corp.
 - 4. Wilkinson Co., Inc.

2.2 MATERIALS

- A. Chute Metal: Aluminum-coated, cold-rolled, commercial steel sheet; ASTM A 463/A 463M, Type 1 with not less than T1-40 coating.
 - 1. Specified (Nominal) Thickness: 16 ga.

2.3 DOORS

- A. Intake Door Assemblies: ASTM A 240/A 240M, Type 302/304 stainless-steel, self-closing units with positive latch and latch handle; Class B labeled; 1-1/2-hour fire rated with 30-minute temperature rise of 250 deg F; and with frame suitable for enclosing chase construction.
 - 1. Door Type: Hopper
 - 2. Size: Manufacturer's standard size for door type, and chute type and diameter indicated.
 - 3. Finish: Manufacturer's standard satin or No. 3 directional polish finish.
 - 4. Locks: Cylinder locks with keys that are removable only when cylinder is locked. For each chute, key locks alike. For each door, furnish four keys.
- B. Heat-Detector System: Interlock system with temperature-rise elements that lock chute doors when temperature in chute reaches a predetermined, adjustable temperature.

- C. Manual Control System: Control system with manual switches that lock doors of chute during shutdown hours and service operations.
- D. Discharge Door Assemblies: Aluminum-coated-steel doors of one-hour fire-rated construction that is suitable for Class B openings; equipped with fusible links that cause doors to close in the event of fire.
 - 1. Direct Vertical Discharge: Provide inclined, horizontally rolling, shutter-type unit.
- E. Access Door Assemblies: Manufacturer's standard ASTM A 240/A 240M, Type 302/304 stainless-steel doors; Class B labeled; 1-1/2-hour fire rated with 30-minute temperature rise of 250 deg F; with frame suitable for enclosing chase construction; and in satin or No. 3 directional polish finish.

2.4 ACCESSORIES

- A. Fire Sprinklers: NPS 1/2 fire sprinklers ready for piping connections.
- B. Flushing Spray Unit: NPS 3/4 spray head unit located in chute above highest intake door, ready for hot-water piping connection, and with access for head and piping maintenance.
- C. Sanitizing Unit: NPS 3/4 disinfecting and sanitizing spray head unit located in chute above highest intake door, including 1-gal. tank and adjustable proportioning valve with bypass for manual control of sanitizing and flushing operation, ready for hot-water piping connection, and with access for head and piping maintenance.

2.5 FABRICATION

- A. General: Factory assemble chutes to greatest extent practical with continuously welded or lock-seamed joints without bolts, rivets, or clips projecting on chute interior. Include intake-door assemblies and chute-support frames at each floor, and chute expansion joints between each support point.
- B. Roof Vent: Fabricate vent unit to extend 48 inches above roof with full-diameter, screened vent and metal safety cap or glass explosion-release cap. Fabricate with roof-deck flange, and with counter-flashing and clamping ring of nonferrous metal compatible with chute metal.
- C. Fire Sprinklers: Comply with NFPA 13. Locate fire sprinklers at or above the top service opening of chutes, within the chute at alternate floor levels in buildings more than two stories tall, and at the lowest service level.
- D. Equipment Access: Fabricate chutes with access for maintaining equipment located within the chute, such as flushing and sanitizing units, fire sprinklers, and plumbing and electrical connections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NFPA 82 requirements and with chute manufacturer's written instructions. Assemble components with tight, non-leaking joints. Anchor securely to supporting structure to withstand impact and stresses on vent units. Install chute and components to maintain fire-resistive construction of chute and enclosing chase.
- B. Install chutes plumb, without offsets or obstructions that might prevent materials from free falling within chutes.

- C. Coordination with Roofing: Anchor roof flanges of chute vents before installing roofing and flashing. Install counter-flashing after roofing and flashing are installed.
- D. Intake and Discharge Doors: Interface door units with throat sections of chutes for safe, snag-resistant, sanitary depositing of materials in chutes by users.
 - 1. Coordinate foot-pedal door operator installation with door and chase installation.
 - 2. Interconnect sanitizer control with door interlock system.
- E. Interlock System: Comply with applicable NECA recommendations.
- F. Test chute components after installation. Complete test operations before installing chase enclosures.

END OF SECTION 14560

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1. DESCRIPTION:

- A. The requirements of this Section shall apply to all plumbing related sections.
- B. Definitions:
 - 1) Exposed: Piping and equipment exposed to view in finished rooms.
 - 2) Option or optional: Contractor's choice of an alternate material or method.

2. QUALITY ASSURANCE:

- A. Products Criteria:
 - 1) Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years.
 - 2) Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 100 miles of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.
 - 3) All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
 - 4) The products and execution of work specified in Division 15 shall conform to the referenced codes and standards per the specifications. Local codes and amendments enforced by the local code official shall be enforced, and by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. In event of conflict, the more stringent shall generally apply.
 - 5) Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

- 6) Assembled Units: Manufacturers of equipment assemblies, which use components made by another manufacturer, assume complete responsibility for the final assembled product.
 - 7) Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
 - 8) Asbestos products or equipment or materials containing asbestos shall not be used.
- B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
- 1) Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
 - 2) Comply with provisions of ASME B31 series "Code for Pressure Piping".
 - 3) Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
- C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Project Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- D. Execution (Installation, Construction) Quality: All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract drawings and specifications shall be referred to the Project Engineer for resolution. Written hard copies or computer files of manufacturer's installation instructions shall be provided at least two weeks prior to commencing installation of any item.
- E. Complete layout shop drawings shall be required for Project Engineer review prior to commencement of construction. Construction work shall not start on any system until the layout drawings have been approved. Layout drawings shall be prepared and shall indicate other building systems requiring coordination.
- F. All plumbing systems shall be installed in accordance with the prevailing code and all relevant standards (ASPE, NFPA, etc.) in effect at the time of permitting.
3. AS BUILT DRAWINGS:
- A. Contractor shall provide as-built drawings of the plumbing system using AutoCAD software and shall provide (.dwg) files on DVD as a part of the close-out documents. As-built drawings shall include all modifications provided during the installation of the

building systems and shall be clearly marked 'AS'BUILT'. Marked-up reproductions of the original design drawings shall not be an acceptable form of as-built drawings.

4. SUBMITTALS:

- B. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- C. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract. Any additional cost required by other trades associated with this modification shall be the responsibility of this contractor.
- D. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- E. Upon request by the Project Engineer, lists of previous installations for selected items of equipment shall be provided. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
- F. Manufacturer's Literature and Data: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
 - 1) Electric motor data and variable speed drive data shall be submitted with the driven equipment.
 - 2) Equipment and materials identification.
 - 3) Fire stopping materials.
 - 4) Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
 - 5) Wall, floor, and ceiling plates.
- G. Coordination Drawings: Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1/4-inch equal to one foot. Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping until layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.

- 1) Mechanical equipment rooms.
 - 2) Interstitial and plenum space.
 - 3) Hangers, inserts, supports, and bracing.
 - 4) Pipe sleeves.
 - 5) Equipment penetrations of floors, walls, ceilings, or roofs.
- H. Maintenance Data and Operating Instructions:
- 1) Listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided.
 - 2) The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.
5. DELIVERY, STORAGE AND HANDLING:
- A. Protection of Equipment:
- B. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
- C. Damaged equipment shall be replaced with an identical unit as determined and directed by the Project Engineer. Such replacement shall be at no additional cost to the owner.
- D. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
- E. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected for the new work.
- F. Cleanliness of Piping and Equipment Systems:
- 1) Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
 - 2) Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
 - 3) The interior of all tanks shall be cleaned prior to delivery and beneficial use by the owner. All piping shall be tested in accordance with the specifications and the latest edition of the prevailing plumbing code. All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.

- 4) Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems

PART 2 - PRODUCTS

1. FACTORY-ASSEMBLED PRODUCTS:

- A. Standardization of components shall be maximized to reduce spare part requirements. Manufacturers of equipment assemblies shall assume complete responsibility for final assembled unit. All components of an assembled unit need not be products of same manufacturer. Constituent parts that are alike shall be products of a single manufacturer. Components shall be compatible with each other and with the total assembly for intended service. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies to deliver specified performance of the complete assembly. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment. Major items of equipment, which serve the same function, shall be the same make and model.

2. COMPATIBILITY OF RELATED EQUIPMENT:

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

3. SAFETY GUARDS:

- A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 1/4-inch bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.
- B. All Equipment shall have moving parts protected from personal injury.

4. LIFTING ATTACHMENTS:

- A. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

5. ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING:

- A. All electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems shall be provided. Premium efficient motors shall be provided. Unless otherwise specified for a particular application, electric motors shall have the following requirements:

- 1) Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical modifications required without additional time or cost to the owner.
- 2) Assemblies of motors, starters, and controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
- 3) Motor sizes shall be selected so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
- 4) Motors utilized with variable frequency drives shall be rated "inverter-ready" per NEMA Standard, MG1.
- 5) Motor Efficiency and Power Factor: All motors, when specified as "high efficiency or Premium Efficiency" by the project specifications on driven equipment.

6. VARIABLE SPEED MOTOR CONTROLLERS:

- A. The combination of controller and motor shall be provided by the respective pump manufacturer, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. pumps, shall be product of a single manufacturer.
- B. Motors shall be premium efficient type, "inverter duty", and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.
- C. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the AC power system.

7. EQUIPMENT AND MATERIALS IDENTIFICATION:

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or shown in the maintenance manuals.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 3/16-inch high of brass with black-filled letters, or rigid black plastic with white letters and shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, fans, etc. shall be identified.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 3/16-inch high riveted or bolted to the equipment.

- D. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.
 - E. Valve Tags and Lists:
 - 1) Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
 - 2) Valve tags: Engraved black filled numbers and letters not less than 1/2-inch high for number designation, and not less than 1/4-inch for service designation on 19 gage, 1-1/2 inches round brass disc, attached with brass "S" hook or brass chain.
 - 3) Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 8-1/2" by 11" shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a punched 3-ring binder notebook. A copy of the valve list shall be mounted in picture frames for mounting to a wall.
 - 4) A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling.
8. PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS:
- A. For Attachment to Concrete Construction: Concrete insert: Type 18, MSS SP-58. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 4 inches thick when approved by the Project Engineer for each job condition.
 - B. Power-driven fasteners: Permitted in existing concrete or masonry not less than 4 inches thick when approved by the Project Engineer for each job condition.
 - C. For Attachment to Steel Construction: MSS SP-58. Welded attachment: Type 22. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 7/8-inch outside diameter.
 - D. Attachment to Metal Pan or Deck: Self tapping metal screws.
 - E. For Attachment to Wood Construction: Wood screws or lag bolts.
 - F. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
 - G. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-5/8 inches by 1-5/8 inches, No. 12 gage, designed to accept special spring held, hardened steel nuts. Trapeze hangers are not permitted for steam supply and condensate piping.
 - 1) Allowable hanger load: Manufacturers rating less 200 pounds.

- 2) Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch u-bolt fabricated from steel rod. Provide type 40 insulation shield, secured by two 1/2-inch galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
- H. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
- 1) General Types (MSS SP-58): Standard clevis hanger: Type 1; provide locknut.
 - 2) Riser clamps: Type 8.
 - 3) Wall brackets: types 31, 32 or 33.
 - 4) Roller supports: type 41, 43, 44 and 46.
 - 5) Saddle support: type 36, 37 or 38.
 - 6) Turnbuckle: types 13 or 15.
 - 7) U-bolt clamp: Type 24.
 - 8) Copper Tube:
 - a) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with isolation tape to prevent electrolysis.
 - b) For vertical runs use epoxy painted or plastic coated riser clamps.
 - c) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
 - d) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.

- e) Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.
- f) Spring hangers are required on all plumbing system pumps one horsepower and greater.
- g) Plumbing Piping (Other Than General Types):
 - 1. Horizontal piping: Type 1, 5, 7, 9, and 10.
- h) Chrome plated piping: Chrome plated supports.
- i) Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
- j) Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 18 gage minimum.

9. PIPE PENETRATIONS:

- A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.
- B. Pipe penetration sleeve materials shall comply with all fire stopping requirements for each penetration.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
 - 1) For sleeves: Extend sleeve 1 inch above finished floor and provide sealant for watertight joint.
 - 2) For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
 - 3) For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- D. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of the Project Architect.
- E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

- F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.
 - G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
 - H. Brass pipe sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.
 - I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 1 inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 1 inch in diameter. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.
10. TOOLS AND LUBRICANTS:
- A. Furnish, and turn over to the owner, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
 - B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
 - C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the Project Architect.
11. WALL, FLOOR AND CEILING PLATES:
- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
 - B. Thickness: Not less than 3/32-inch for floor plates. For wall and ceiling plates, not less than 0.025-inch for up to 3 inch pipe, 0.035-inch for larger pipe.
 - C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

PART 3 - EXECUTION

1. ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING:

- A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.
- B. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.
- C. Operating personnel access and observation provisions: all equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.
- D. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.
- E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- F. Cutting Holes:
 - 1) Holes through concrete and masonry shall be cut by rotary core drill.
 - 2) Holes shall be located to avoid interference with structural members such as beams, tendons, PT cables or grade beams. Holes shall be laid out in advance and drilling done only after approval. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Project Architect for approval.
 - 3) Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
- G. Interconnection of Instrumentation or Control Devices: Generally, electrical interconnections are not shown but must be provided.
- H. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

- I. Protection and Cleaning:
 - 1) Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations.
 - 2) Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
 - J. Concrete and Grout: Concrete and shrink compensating grout 3000 psi minimum, shall be used for all pad or floor mounted equipment. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
 - K. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
 - L. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers putty.
 - M. Switchgear drip protection: every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.
 - N. Inaccessible Equipment:
 - 1) Where the Project Architect determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Owner.
 - 2) The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.
2. TEMPORARY PIPING AND EQUIPMENT:
- A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities as a part of the base scope of work and shall be provided at no additional cost to owner.

- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities.
- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

3. RIGGING:

- A. Openings in building structures shall be planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered and will be considered by the Owner under specified restrictions of phasing and service requirements as well as structural integrity of the building.
- C. All openings in the building shall be closed when not required for rigging operations to maintain proper environment in the facility for Owner operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.
- E. Contractor shall check all clearances, weight limitations and shall provide a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Rigging plan and methods shall be referred to Project Architect for evaluation prior to actual work.

4. PIPE AND EQUIPMENT SUPPORTS:

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the Project Architect.
- B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.

- C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 1/2-inch clearance between pipe or piping covering and adjacent work shall be provided.
 - D. For horizontal and vertical plumbing pipe supports, refer to the latest edition of the prevailing plumbing code and these specifications.
 - E. Overhead Supports:
 - 1) The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
 - 2) Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
 - 3) Tubing and capillary systems shall be supported in channel troughs.
 - F. Floor Supports:
 - 1) Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
 - 2) Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 2 inch excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
 - G. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.
5. LUBRICATION:
- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.
 - B. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
 - C. All lubrication points shall be extended to one side of the equipment.
6. PLUMBING SYSTEMS DEMOLITION:

- A. Rigging access, other than indicated on the drawings, shall be provided after approval for structural integrity. Such access shall be provided without additional cost or time to the Owner. Where work is in an operating plant, approved protection from dust and debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
 - B. In an operating facility, cleanliness and safety shall be maintained. The facility shall be kept in an operating condition. Personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work shall be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris shall not be permitted to accumulate in the area to the detriment of operation. All flame cutting shall be performed to maintain the fire safety integrity. Adequate fire extinguishing facilities shall be available at all times. All work shall be performed in accordance with recognized fire protection standards.
 - C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from the property. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
7. CLEANING AND PAINTING:
- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Owner, the facilities, equipment and systems shall be thoroughly cleaned and painted.
 - B. In addition, the following special conditions apply: Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
 - C. The following Material And Equipment shall NOT be painted:
 - 3) Motors, controllers, control switches, and safety switches.
 - 4) Control and interlock devices.
 - 5) Regulators.
 - 6) Pressure reducing valves.
 - 7) Control valves and thermostatic elements.

- 8) Lubrication devices and grease fittings.
 - 9) Copper, brass, aluminum, stainless steel and bronze surfaces.
 - 10) Valve stems and rotating shafts.
 - 11) Pressure gages and thermometers.
 - 12) Glass.
 - 13) Name plates.
- D. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint obtained from manufacturer or computer matched.
- E. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer.
- F. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
- G. The final result shall be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this.
8. IDENTIFICATION SIGNS:
- A. Laminated plastic signs, with engraved lettering not less than 3/16-inch high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
 - B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance shall be placed on factory built equipment.

9. STARTUP AND TEMPORARY OPERATION:

- A. Start up of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation.

10. OPERATING AND PERFORMANCE TESTS:

- A. Prior to the final inspection, all tests shall be performed and submit the test reports and records to the Commissioning Agent.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests such systems respectively during first actual seasonal use of respective systems following completion of work.

11. OPERATION AND MAINTENANCE MANUALS:

- A. Provide four bound copies with the close-out documents. The Operations and maintenance manuals shall be delivered to Project Architect not less than 30 days prior to completion of a phase or final inspection.
- B. All new and temporary equipment and all elements of each assembly shall be included.
- C. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
- D. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.
- E. Lubrication instructions, type and quantity of lubricant shall be included.
- F. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.
- G. Set points of all interlock devices shall be listed.
- H. Trouble-shooting guide for the control system troubleshooting guide shall be inserted into the Operations and Maintenance Manual.
- I. The combustion control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.
- J. Emergency procedures.

End of Section

SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1. DESCRIPTION:

This section describes the requirements for water meters and pressure gages.

2. SUBMITTALS:

A. Submit in accordance with GENERAL CONDITIONS and SUPPLEMENTARY GENERAL CONDITIONS.

B. Manufacturer's Literature and Data:

1. Water Meter.
2. Pressure Gages.
3. Product certificates for each type of meter and gauge.

C. Operations and Maintenance manual shall include:

1. System Description
2. Major assembly block diagrams
3. Troubleshooting and preventive maintenance guidelines
4. Spare parts information.

3. SHIPPING, STORAGE AND HANDLING:

A. Protect products from damage, weather and contamination. Clean or replace as required prior to installation. Protect all openings with caps and plugs.

4. AS-BUILT DOCUMENTATION:

A. Four sets of manufacturer's literature and data updated to include submittal review comments, operations and maintenance procedures and any equipment substitutions. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished.

Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

PART 2 – PRODUCTS

1. DISPLACEMENT WATER METER:

- A. For pipe sizes under 2 inches, the water meter shall be displacement type, full size disc, magnetic drive, sealed register, and fully conform to AWWA C700.
- B. The water meter shall be rated for use at a working pressure of 150 psig.
- C. The meter case, bottom caps, and register box lids shall be constructed from cast bronze.
- D. High resolution LCD encoder.

2. WATER METER STRAINER:

- A. All meters sizes 2 inches and above, shall be fitted with a bronze inlet strainer with top access. The strainer shall conform to AWWA 702.

3. PRESSURE GAGES:

- A. ANSI B40.1 all metal case 4-1/2 inches diameter, bottom connected throughout, graduated as required for service, and identity labeled. Range shall be 0 to 200 psi gauge.
- B. The pressure element assembly shall be bourdon tube. The mechanical movement shall be lined to pressure element and connected to pointer.
- C. The dial shall be non-reflective aluminum with permanently etched scale markings graduated in psi.
- D. The pointer shall be dark colored metal.
- E. The window shall be glass.
- F. The ring shall be brass or stainless steel.
- G. The accuracy shall be grade A, plus or minus 1 percent of middle half of scale range.

PART 3 - EXECUTION

1. INSTALLATION:

- A. Direct mounted pressure gages shall be installed in piping tees with pressure gage located on pipe at the most readable position.
- B. Valves and snubbers shall be installed in piping for each pressure gage.
- C. Test plugs shall be installed on the inlet and outlet pipes all heat exchangers or water heaters serving more than one plumbing fixture.
- D. Pressure gages shall be installed where indicated on the drawings and at the following locations:
 - 1. Building water service entrance into building
 - 2. Inlet and outlet of each pressure reducing valve
- E. Water meter installation shall conform to AWWA C700, AWWA C701, and AWWA C702.

2. FIELD QUALITY CONTROL:

- A. The meter assembly shall be visually inspected and operationally tested. The correct multiplier placement on the face of the meter shall be verified.
- B. TAB or the plumbing contractor shall spot-check at least 10% of installed gages and thermometers with a calibrated measuring device to confirm installed accuracy.

END OF SECTION

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1. DESCRIPTION:

- A. This section describes the requirements for general-duty valves for domestic water and sewer systems.

2. SUBMITTALS:

- A. Submit in accordance with GENERAL CONDITIONS and SUPPLEMENTARY GENERAL CONDITIONS.
- B. Manufacturer's Literature and Data:
 - 1. Valves.
 - 2. Backflow Preventers.
 - 3. Pressure Reducing Valves.
 - 4. Backwater Valves
 - 5. All items listed in Part 2 - Products.

3. DELIVERY, STORAGE, AND HANDLING:

- A. Valves shall be prepared for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Valves shall be prepared for storage as follows:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature.

PART 2 - PRODUCTS

1. VALVES:

- A. Valves shall be bronze with brass and shall not be more than 15 percent zinc.
- B. Valves in insulated piping shall have 2 inch stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.
- C. Exposed Valves over 2-1/2 inches installed at an elevation over 12 feet shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.
- D. Ball valves, pressure regulating valves, gate valves, globe valves, and plug valves used to supply potable water shall meet the requirements of NSF 61.
- E. Shut-off:
 - 1. Cold, Hot and Re-circulating Hot Water:
 - a. 2-1/2 inches and smaller: Ball, MSS SP-72, SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 150 psig and a CWP rating of 600 psig. The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be solder,
 - b. 3 inches and larger: Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 200 psig. The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A 536, ductile iron.

2. Balancing:

- A. Hot Water Re-circulating, 3 inches and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 1/4" NPT tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing

the balance position. All valves shall have calibrated nameplates to assure specific valve settings.

3. Check:

1. Check valves 3 inches and smaller shall be class 125, bronze swing check valves with non metallic Buna-N disc. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 200 psig. The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B 62, solder joints, and PTFE or TFE disc.

4. WATER PRESSURE REDUCING VALVE AND CONNECTIONS:

- A. 3 inches or smaller: The pressure reducing valve shall consist of a bronze body and bell housing, a separate access cover for the plunger, and a bolt to adjust the downstream pressure. The bronze bell housing and access cap shall be threaded to the body and shall not require the use of ferrous screws. The assembly shall be of the balanced piston design and shall reduce pressure in both flow and no flow conditions. The assembly shall be accessible for maintenance without having to remove the body from the line.
- B. 4 inches and larger: The pressure reducing valve shall consist of a flanged cast iron body and rated to 200-psig. The valve shall have a large Hycar diaphragm for sensitive response.
- C. The regulator shall have a tap for pressure gauge.
- D. Pressure regulators shall have accurate pressure regulation to +/- 1 psig.
- E. Connections Valves and Strainers: shut off valves shall be installed on each side of reducing valve and a bypass line equal in size to the regulator inlet pipe shall be installed with a normally closed globe valve. A strainer shall be installed on inlet side of, and same size as pressure reducing valve. A pressure gage shall be installed on the low pressure side of the line.

5. BACKWATER VALVE:

- A. The backwater valve shall have a cast iron body, automatic type ABS valve seat and flapper which are slightly open during periods of non operation. The cleanout shall be extended to the finish floor and fit with a threaded countersunk plug. A clamping device shall be included when the cleanout extends through the waterproofing membrane.

- B. When the backwater valve is installed greater than 24 inches below the finish floor elevation, a pit or manhole large enough for a repair person can enter to service the backwater valve shall be installed.

6. BACKFLOW PREVENTERS:

- A. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination. The backflow prevention assembly shall be ASSE 1013 listed and certified.
- B. Reduced pressure backflow preventers shall be installed in the following applications.
 - 1. Water make up to heating systems, cooling tower, chilled water system, generators, and similar equipment consuming water.
 - 2. Atmospheric Vacuum Breaker: ASSE 1001
 - a. Hose bibs and sinks w/threaded outlets.
 - b. All kitchen equipment, if not protected by air gap.
- C. The reduced pressure principle backflow prevention assembly shall be ASSE listed 1013 with full port OS&Y gate valves and an integral relief monitor switch. The main body and access cover shall be epoxy coated duct iron conforming to ASTM A536 grade 4. The seat ring and check valve shall be Noryl (NSF listed). The stem shall be stainless steel conforming to ASTM A276. The seat disc elastomer shall be EPDM. The checks and the relief valve shall be accessible for maintenance without removing the device from the line. An epoxy coated wye type strainer with flanged connections shall be installed on the inlet.
- D. The atmospheric vacuum breaker shall be ASSE listed 1001. The main body shall be either cast bronze. All internal polymers shall be NSF listed. The seat disc elastomer shall be silicone. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable.
- E. The double check detector backflow prevention assembly shall be ASSE listed 1048 and supply with full port OS&Y gate valves. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade. The seat ring and check valve shall be Noryl (NSF listed). The stem shall be stainless steel conforming to ASTM A 276. The seat disc elastomers shall be EPDM. The first and second check valve shall be accessible for maintenance without removing

the device from the line. Provide hot-box as required to prevent freezing. Coordinate power requirements with electrical contractor.

PART 3 - EXECUTION

1. EXAMINATION:

- A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.
- B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
- C. Threads on valve and mating pipe shall be examined for form and cleanliness.
- D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

2. VALVE INSTALLATION:

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.
- C. Valves shall be installed in horizontal piping with stem at or above center of pipe.
- D. Valves shall be installed in a position to allow full stem movement.
- E. Install chain wheels on operators for valves 4 inches and larger and more than 12 feet above floor. Chains shall be extended to 60 inches above finished floor.
- F. Check valves shall be installed for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
3. ADJUSTING:
 - A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves shall be replaced if persistent leaking occurs.

End of Section

SECTION 22 11 00 - FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1. DESCRIPTION:

- A. Domestic water systems, including piping, valves, equipment and all necessary accessories as designated in this section.

2. SUBMITTALS:

- A. Submit in accordance with GENERAL CONDITIONS and SUPPLEMENTARY GENERAL CONDITIONS.

- B. Manufacturer's Literature and Data:

- 1. All items listed in Part 2 - Products.

3. DELIVERY, STORAGE AND HANDLING:

- A. Protect all products from damage, weather and contamination. Clean all product as required prior to installation. Protect all openings with caps and plugs.

4. QUALITY ASSURANCE:

- A. For mechanical pressed sealed fittings, only tools approved by fitting manufacture shall be used. Mechanical pressed fittings shall be installed by manufacturer-trained workers.
- B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.
- C. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

5. SPARE PARTS:

- A. For mechanical pressed sealed fittings provide tools required for each pipe size used at the facility.

PART 2 – PRODUCTS:

1. UNDERGROUND WATER SERVICE PIPING:

- A. From inside face of exterior wall to a distance of approximately 5 feet outside of building and underground inside building, material selected shall be the same for the size specified.
- B. 3 inch Diameter and Over: Ductile iron, AWWA C151, 125 psi water steam pressure (WSP), exterior bituminous coating, and cement lined. Provide flanged and anchored connection to interior piping.
- C. Under 3 inch Diameter: Copper tubing, ASTM B88, Type K, seamless, annealed. Fittings as specified herein. Use brazing alloys, AWS A5.8, Classification BCuP.
- D. Piping shall not have joints installed underneath the building. All piping will be continuous and without joints when installed under the building slab.

2. ABOVE GROUND (INTERIOR) WATER PIPING:

- 1. All products, components, etc. specified herein are manufactured by and/or are available from Zurn PEX, Inc. tubing manufacturer or prior approved equal.
- 2. Tubing tested in general accordance with ASTM E84 for a flame spread/smoke developed index of 25/50 or less for the following PEX tube sizes encased with ½ inch fiberglass insulation;
 - 1 1/4 inch
 - 1 1/2 inch
 - 2 inch
- 3. Tubing tested in general accordance with ASTM E84 for a flame spread/smoke developed index of 25/50 or less for the following PEX tube sizes;
 - 3/8 inch
 - 1/2 inch
 - 5/8 inch
 - 3/4 inch
 - 1 inch

4. To provide a PEX tubing hot and cold potable water distribution system, which is manufactured, fabricated and installed to comply with regulatory agencies and to maintain performance criteria stated by the PEX tubing manufacturer without defects, damage or failure
 - Comply with NSF Standard 14
 - Comply with NSF Standard 61
 - Show compliance with ASTM F877
5. Manufacturer's Warranty shall cover the repair or replacement of improperly installed tubing and fittings proven defective as well as incidental damages. Warranty period for PEX tubing and subsequent system shall be 25 year non-prorated warranty against failure due to defect in material or workmanship, beginning with the date of installation. It is the installer's responsibility to avoid mixing fittings manufactured by others as it will reduce the owner's warranty.
6. Tubing:
 - a. Cross-linked polyethylene (PEX) manufactured by the Silane method
 - b. Non-barrier type
 - c. Shall have a pressure and temperature rating of 160 PSI at 73°F, 100 PSI at 180°F and 80 PSI at 200°F
 - d. Tubing shall have a minimum of 6 months UV protection
 - e. Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third-party agency
 - f. Must have Pex 5006 chlorine designation for hot water recirculation
 - g. Plenum tested in accordance with ASTM E84
 - h. Fittings must be brass (F1807) in compliance with NSF-Annex "G" for no lead or engineered polymer (F2159) (Acudel) corrosion resistant type.
 - i. Must have a 25 year non-prorated warranty
7. Fittings:
 - a. Fittings shall be manufactured by Zurn PEX Inc or installed pipe manufacturer equal, identified by the letters "Q" or "Z" Manufactured in accordance with ASTM F1807 or ASTM F2159 and/or comply with ASTM F877 system standard as identified on the fitting
8. Crimp Systems
 - a. Listed to ASTM F877.
 - b. Copper Crimp Ring: Listed to ASTM F1807 and/or ASTM F877.

9. Tools

- a. Quickclamp tools shall be supplied by the PEX tubing manufacturer, identified by the manufacturer name on the tool.
- b. Copper Crimp Ring tools shall be supplied by the PEX tubing manufacturer or approved by the PEX tubing manufacturer for use.

10. Valves: Shall be of the plastic or metal type, meeting the requirements of ASTM F877, identified as such with the appropriate mark on the product

11. EXECUTION: Comply with manufacturer's product data, including product technical bulletins, technical memos, installation instructions and design drawings.

12. EXAMINATION: Site Verification of Conditions:

- a. Verify that site conditions are acceptable for the installation of the PEX potable water system
- b. Do not proceed with installations of the PEX potable water system until unacceptable conditions are corrected

13. INSTALLATION

- a. Install PEX tubing in accordance with tubing manufacturer's recommendations and as indicated in the manufacturer installation guide
- b. Do not install PEX tubing within 6 inches of gas appliance vents or within 12 inches of any recessed light fixtures
- c. Do not solder within 18 inches of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections
- d. Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer
- e. Do not expose PEX tubing to direct sunlight for more than 6 months
- f. Use grommets or sleeves at the penetration for PEX tubing passing through metal studs
- g. Use a PEX manufacturer recommended fire stop sealant manufacturer
- h. Protect PEX tubing with sleeves where abrasion may occur
- i. Use nail plates where PEX tubing penetrates wall stud or joists and has the potential for being struck with a screw or nail
- j. Allow slack of approximately 1/8 inch per foot of tube length to compensate for expansion and contraction
- k. Minimum horizontal supports are to be installed not less than 32 inches between hangers in accordance with plumbing codes and the manufacturer installation guide

- I. Pressurize PEX tubing in accordance with applicable codes or in the absence of applicable codes, test pressure shall be at least equal to normal system working pressure, but not less than 40 PSI water or air and not greater than 225 PSI water, 125 PSI air

14. FIELD QUALITY CONTROL: Site Tests:

- a. To ensure system integrity, pressure test the system before covering tubing in concrete and after other trades have worked in the vicinity of the tubing.
- b. Repair and replace any product that has been damaged according to manufacturer's recommendation.

15. PROTECTION: Protect installed work from damage due to subsequent construction activity on the site.

3. EXPOSED WATER PIPING IN OCCUPIED AREAS:

- A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, and equipment.

1. Pipe: Fed. Spec. WW-P-351, standard weight.
2. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
3. Nipples: ASTM B 687, Chromium-plated.
4. Unions: Mss SP-72, SP-110, Brass or Bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

4. TRAP PRIMER WATER PIPING:

- A. Pipe: Copper tube, ASTM B88, type K, hard drawn.
- B. Fittings: Bronze castings conforming to ANSI B16.18 Solder joints.
- C. Solder: ASTM B32 composition Sb5. Provide non-corrosive flux.

5. STRAINERS:

- A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

- B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.
- C. Body: Smaller than 3 inches, brass or bronze; 3 inches and larger, cast iron or semi-steel.

6. DIELECTRIC FITTINGS:

- A. Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

7. STERILIZATION CHEMICALS:

- A. Hypochlorites ANSI/AWWA B300-10
- B. Liquid Chlorine ANSI/AWWA B301-10

9. WATER HAMMER ARRESTER:

- A. Closed copper tube chamber with permanently sealed 60 psig air charge above a Double O-ring piston. Two high heat Buna-N O-rings pressure packed and lubricated with FDA approved silicone compound. All units shall be designed in accordance with ASSE 1010 for sealed wall installations without an access panel. Size and install in accordance with Plumbing and Drainage Institute requirements (PDI WH 201). Provide water hammer arrestors at:
 - 1. All solenoid valves.
 - 2. All groups of two or more flush valves.
 - 3. All quick opening or closing valves.

PART 3 - EXECUTION

1. INSTALLATION:

- A. General: Comply with the International Plumbing Code, local building codes, accepted standards and the following:
 - 1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those not furnished by this contractor. Provide shut-off cocks at all equipment.
 - 2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.

3. All pipe runs shall be laid out to avoid interference with other work.
4. Install union and shut-off valve on pressure piping at connections to equipment.
5. Pipe Hangers, Supports and Accessories:
 - a. All piping shall be supported per the International Plumbing Code, Chapter No. 3.
 - b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with red lead or zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
 - c. Floor, Wall and Ceiling Plates, Supports, Hangers:
 - 1) Solid or split unplated cast iron.
 - 2) All plates shall be provided with set screws.
 - 3) Pipe Hangers: Height adjustable clevis type.
 - 4) Adjustable Floor Rests and Base Flanges: Steel.
 - 5) Concrete Inserts: "Universal" or continuous slotted type.
 - 6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 - 7) Riser Clamps: Malleable iron or steel.
 - 8) Rollers: Cast iron.
 - 9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
 - 10) Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gauge steel. The shield shall be sized for the insulation.
 - 11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 20 feet for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
 - 12) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream section of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints.
6. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Penetrations:

- a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases. Completely fill and seal clearances between raceways and openings with the fire stopping materials.
 - b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant. Provide Link-Seal at all slab penetrations 3" or greater.
- B. Piping shall conform to the following:
 - 1. Domestic Water:
 - a. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Install domestic hot water circulating lines with no traps.
 - b. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

2. TESTS:

- A. General: Test system either in its entirety or in sections.
- B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 100 psi gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested.
- C. All Other Piping Tests: Test new installed piping under 1 1/2 times actual operating conditions and prove tight.

3. STERILIZATION:

- A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.
- B. Use liquid chlorine or hypochlorites for sterilization.

End of Section

SECTION 22 11 23
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1. DESCRIPTION:
 - A. Hot water recirculation pump.
2. QUALITY ASSURANCE:
 - A. Components shall be furnished by a single manufacturer and the system shall be the standard cataloged product of the manufacturer.
3. SUBMITTALS:
 - A. Submit in accordance with GENERAL CONDITIONS and SUPPLEMENTARY GENERAL CONDITIONS.
 - B. Manufacturer's Literature and Data:
 1. Pump:
 - a. Manufacturer and model.
 - b. Operating speed.
 - c. Capacity.
 - d. Characteristic performance curves.
 2. Motor:
 - a. Power rating.
 - b. Speed.

- c. Electrical Characteristics.
 - d. Efficiency.
 - C. Associated trim, check valves, isolation valves, balancing valves,
 - D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts.
- 4. DELIVERY, HANDLING AND STORAGE:
 - A. Protect all products from damage, weather and contamination. Clean potable wetted surfaces of any contamination; protect all openings with plugs and caps.

PART 2 - PRODUCTS

- 1. INLINE HOT WATER RECIRCULATING PUMP:
 - A. Centrifugal in-line horizontal oil lubricated pump designed for quiet operation and 125 psi working pressure.
 - B. Bronze body construction, furnished as scheduled and detailed on the drawings. Pump shall be non-overloading at any point on the pump curve.
 - C. Pump controlled from on/off aquastat located at pump. In addition, the pump shall be provided with "on-off" switch for shut down. In the inlet and outlet piping of the pump shutoff valves shall be installed to permit service to the pump without draining the system. A check valve shall be installed in the pump discharge piping immediately downstream of the pump.

PART 3 - EXECUTION

1. STARTUP AND TESTING

- A. Install unit with supports and vibration isolation as required. Furnish complete unit start-up report, including final adjustment settings to circuit balancing valves.
- B. System Test: After installation is completed provide an operational test of the completed system including flow rates, pressure compliance, alarms and all control functions.

End of Section

SECTION 22 13 00 - FACILITY SANITARY AND VENT PIPING

PART 1 - GENERAL

1. DESCRIPTION:

- A. This section pertains to sanitary sewer and vent systems, including piping, fittings and equipment and all necessary accessories as designated in this section.

2. SUBMITTALS:

- A. Submit in accordance with GENERAL CONDITIONS and SUPPLEMENTARY GENERAL CONDITIONS.
- B. Manufacturer's Literature and Data:
 - 1) Piping.
 - 2) Floor Drains.
 - 3) Grease Removal Unit.
 - 4) Cleanouts.
 - 5) All items listed in Part 2 - Products.

3. DELIVERY, STORAGE AND HANDLING:

- A. Deliver and store all products in accordance with GENERAL CONDITIONS and SUPPLEMENTARY GENERAL CONDITIONS. Protect from damage and contamination, and clean prior to installation.

PART 2 - PRODUCTS

1. SANITARY WASTE, DRAIN, AND VENT PIPING:

- A. Polyvinyl Chloride (PVC):
 - 1) Polyvinyl chloride (PVC) pipe and fittings are permitted.
PVC piping and fittings shall NOT be used for the following applications:
 - a. Waste collected from steam condensate drains

- b. Exposed inside of ceiling return plenums

2) Pipe and Fittings:

- a. Pipe shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a cell class of 12454 as identified in ASTM D 1784. PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785 and ASTM D 2665. Injection molded PVC DWV fittings shall conform to ASTM D 2665. Fabricated PVC DWV fittings shall conform to ASTM F 1866. All pipe and fittings shall be manufactured in the United States. Pipe and fittings shall conform to NSF International Standard 14.
- b. PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

2. SPECIALTY PIPE FITTINGS:

- A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
 - 1) For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F 477 or ASTM D5926.
 - 2) For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

3. CLEANOUTS

- A. Cleanouts shall be the same size as the pipe, up to 4 inches; and not less than 4 inches for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 24 inches shall be provided for clearing a clogged sanitary line.
- B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with

hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 2 inches. When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Two way cleanouts shall be provided where indicated on drawings and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.

- C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 24 inches above the floor. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 6 by 6 inches shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.
- D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

4. FLOOR DRAINS:

- A. Floor drain shall comply with ANSI A112.6.3 and shall comply with the drawing fixture schedule, furnished and installed with necessary trim for the floor system. A hubless connection shall be provided for connection to cast iron pipe, a solvent joint is permitted for PVC connection

5. TRAPS:

- A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed pipes shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass, cast iron, or PVC. Slip joints are not permitted on sewer side of trap. Traps shall

correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be by connected service or fixture.

6. TRAP SEAL PRIMER VALVES AND TRAP SEAL PRIMER SYSTEMS:

- A. The trap seal primer valve shall be hydraulic, supply type with a pressure rating of 125 psig and conforming to standard ASSE 1018.
 - 1) The inlet and outlet connections shall be NPS ½ inch.
 - 2) The trap seal primer valve shall be fully automatic with an all brass or bronze body.
 - 3) The trap seal primer valve shall be activated by a drop in building water pressure, no adjustment required.
 - 4) The trap seal primer valve shall include a manifold when serving two, three, or four traps.
 - 5) The manifold shall be omitted when serving only one trap.

7. WATERPROOFING:

- A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 2 inches above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. Link-Seal shall be provided for all pipe penetrations 3" and over. A waterproof caulked joint shall be provided at the top hub.

PART 3 - EXECUTION

1. PIPE INSTALLATION:

- A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.
- B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those not furnished by the plumbing contractor.

- C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
- D. All pipe runs shall be laid out to avoid interference with other work.
- E. The piping shall be installed above accessible ceilings where possible.
- F. The piping shall be installed to permit valve servicing or operation.
- G. Unless specifically indicated on the drawings, the minimum slope shall be 2% slope.
- H. The piping shall be installed free of sags and bends.
- I. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- J. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.
- K. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.

2. JOINT CONSTRUCTION:

- 1) For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

3. SPECIALTY PIPE FITTINGS:

- A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.
- B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

4. PIPE HANGERS, SUPPORTS AND ACCESSORIES:

- A. All piping shall be supported according to the most restrictive requirements of the International Plumbing Code (IPC) and COMMON WORK RESULTS FOR PLUMBING, and these specifications.
- B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- C. Horizontal piping and tubing shall be supported within 12 inches of each fitting or coupling.
- D. The maximum spacing for plastic pipe shall be 4 feet.
- E. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 15 feet.
- F. In addition to the requirements in COMMON WORK RESULTS FOR PLUMBING, floor, wall and ceiling plates, supports, hangers shall have the following characteristics:
 - 1) Solid or split unplated cast iron.
 - 2) All plates shall be provided with set screws.
 - 3) Height adjustable clevis type pipe hangers.
 - 4) Adjustable floor rests and base flanges shall be steel.
 - 5) Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 - 6) Riser clamps shall be malleable iron or steel.

- 7) Rollers shall be cast iron.
- G. Miscellaneous materials shall be provided for proper installation of hangers, supports and accessories. If the vertical distance exceeds 20 feet for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.
- H. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- I. Penetrations:
- 1) Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
 - 2) Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant.
- J. Piping shall conform to the following:
- 1) Waste and Vent Drain to main stacks:

Pipe Size	Minimum Pitch
2 1/2 inches and smaller	2%
3 inches and larger	1%

- K. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

5. TESTS:

- A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.
- B. Waste System tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.

- 1) If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 10 foot head of water. In testing successive sections, test so that each joint or pipe has been submitted to a test of at least a 10 foot head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
- 2) After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.

End of Section

SECTION 22 33 00 - DOMESTIC WATER HEATERS

PART 1 - GENERAL

PART 1 - PRODUCTS

1. FUEL-FIRED WATER HEATERS – GENERAL

- A. Efficiency shall be minimum as scheduled. No heater shall be installed at less than 85% efficient.
- B. Burner shall be listed for use and the heater installed with a vent system compliant in material and construction with the local codes and manufacturer's installation directions.
- C. Heater shall be factory equipped with low and high fire safeties, thermostatically controlled burner.
- D. Install heater with equipment base / support and with acid neutralization receptacle and drained to nearest approved disposal. Condensing burners shall be vented with an approved vent material sized as required by the manufacturer's IOM.
- E. For type B Combustion vents, size and install according in compliance with the local code and the manufacturer's IOM, NFPA 54.
- F. In all cases, the contractor shall terminate vents and intakes in only those locations permitted by the local code authority and NFPA 54, locally-adopted fuel gas code.
- G. Heater shall be installed with an ANSI Z21.18 compliant gas pressure regulator matching the unit inlet pressure and flow. Automatic gas valves shall be furnished and installed and be appliance type, electrically operated with on-off automatic control, conforming to ANSI Z21.21.

2. DOMESTIC STORAGE TANK WATER HEATERS:

- A. The tank construction shall be steel shell, with an inner tank liner complying with NSF 61 for barrier materials for potable water. The inner liner shall be extended into the tappings. The vessel shall be ASME Boiler and Pressure Vessel Code (BPVC), section VIII, fabricated with a pressure rating of 150 psig. Tapping (openings) shall be Factory fabricated of materials compatible with the tank and in accordance with appropriate ASME standards B1.20.1 for piping

connections, pressure and temperature relief valve, pressure gauge, thermometer, drain valve, anode rods and controls as required. Tappings shall comply with the following:

1. 2 inch and smaller: Threaded ends according to ASME B1.20.1.
2. 2 1/2-inch and Larger: Flanged ends according to ASME B16.5 for steel and stainless steel flanges, and according to ASME B 16.24.

B. Tank insulation shall comply with ASHRAE 90.1.

C. For electric domestic hot water heater sizes greater than 9 KW, the heating element shall be arranged in multiples of three elements. For heaters less than 9 KW, the heater elements shall be arranged in double elements.

D. The domestic hot water heaters shall have screw in or bolt in immersion type, thermostatically adjustable.

E. Combination Pressure and Temperature Relief Valves shall be ASME rated and stamped for combination temperature and pressure relief valves. One or more relief valves with total relieving capacity at least as great as the heat input shall be included. The pressure setting shall be less than the domestic water heater working pressure rating.

F. The anode rod shall be replaceable magnesium.

G. The drain valve shall be corrosion resistant metal complying with ASSE 1005.

4. TANKLESS DOMESTIC WATER HEATER

A. Tankless, domestic water heaters shall be constructed with copper piping or tubing complying with NSF 61 barrier materials for potable water without storage capacity.

A. The pressure rating shall be 150 psig.

B. For electric units, the heating element shall be resistance heating system type.

C. Temperature control shall be made with flow control fittings and / or thermostat.

D. The safety control shall be a high temperature limit cutoff device or system.

- F. The heater shall have a bracket for wall mounting and have an aluminum or steel with enameled jacket.

5. DOMESTIC HOT WATER COMPRESSION TANKS

- A. A steel pressure rated tank constructed with welded joints and factory installed butyl rubber diaphragm shall be installed as scheduled. The air pre charge shall be set to minimum system operating pressure at tank.
- A. The tappings shall be factory fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.
- B. The interior finish shall comply with NSF 61 barrier materials for potable water tank linings and the liner shall extend into and through the tank fittings and outlets.
- D. The air charging valve shall be factory installed.

6. ELEVATED ELECTRIC WATER HEATER DRAIN PAN

- A. A stainless steel or non-reactive plastic drain pan shall be provided that is minimum of 2" containment height. The drain pan shall include a drain outlet not less than NPS ¾" and equipped with ASME B1.20.7 garden hose threads or piped with an indirect connection to a drain – see drawings and details.

7. HEAT TRAPS

- A. Heat traps shall be installed in accordance with ASHRAE 90.1, latest edition.

8. COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

- A. The combination temperature and pressure relief valves shall be ASME rated and stamped and include a relieving capacity at least as great as the heat input and include a pressure setting less than the water heater's working pressure rating.

9. THERMOMETERS:

The thermometers shall be straight stem, iron case, red reflecting mercury thermometer or red liquid-filled thermometers, approximately 7 inches high, 40 to 240°F.

PART 3 - EXECUTION

1. INSTALLATION:

- A. Water heaters shall be installed on concrete bases unless elevated above the floor. For residential installations and as otherwise indicated on the drawings or directed by local code authority, install floor-mounted water heaters with a minimum 18" elevation base.
- B. The water heaters shall be installed level and plumb and securely anchored.
- C. The water heaters shall be installed and connected in accordance with manufacturer's written instructions.
- D. All pressure and temperature relief valves discharge shall be piped to nearby floor drains.
- E. Thermometers shall be installed on the water heater inlet and outlet piping.
- F. The thermostatic control shall be set for a maximum setting of 130 degrees F.
- F. Shutoff valves shall be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.
- G. All manufacturers' required clearances shall be maintained.
- H. The domestic water heaters shall be installed with seismic restraint devices where required.
- I. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge by positive air gap into a floor drain.
- J. Piping type heat traps shall be installed on the inlet and outlet piping of the electric domestic hot water heater storage tanks.

- K. Water heater drain piping shall be installed as indirect waste to spill by positive air gap into open drains or over floor drains. Hose end drain valves shall be installed at low points in water piping for electric domestic hot water heaters without integral drains.

2. LEAKAGE TEST:

Before piping connections are made, water heaters shall be tested with hydrostatic pressure of 200 psi and 240 psi for a unit with a MAWP of 160 psi. Any domestic water heater leaking water shall be replaced with a new unit at no additional cost to the owner.

3. PERFORMANCE TEST:

A. All of the remote water outlets shall be tested to ensure a supply temperature of 110°F and a supply temperature of 140°F at kitchens, at all times. If necessary, make all corrections to balance the return water system or reset the thermostat to make the system comply with design requirements.

B. Temperature limiting devices shall be tested to ensure proper function.

End of Section

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 – GENERAL

1. DESCRIPTION:

- A. Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories, including:

- 1. Water Closets
- 2. Lavatories
- 3. Sinks
- 4. Toilet Seats
- 5. Shower Units
- 6. Fixture Trims

2. SUBMITTALS:

- A. Submit in accordance with GENERAL CONDITIONS and SUPPLEMENTARY GENERAL CONDITIONS.
- B. Submit plumbing fixture information in an assembled brochure, showing cuts and full detailed description of each fixture, including sizes, rough in dimensions, utility sizes, trim and finishes.

3. OPERATION AND MAINTENANCE DATA:

- A. Submit O&M Manuals. Include fixture exploded view and replacement parts list.

4. WARRANTY:

- A. Provide one year warranty on parts and labor.

PART 2 – PRODUCTS

1. GENERAL:

- A. Refer to Plumbing Fixture Schedule on drawings for further information.

2. STAINLESS STEEL:

- A. Corrosion-resistant Steel (CRS):
- B. Plate, Sheet and Strip: CRS flat products shall conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
- C. Finish: Exposed surfaces shall have standard polish (ground and polished) equal to NAAMM finish Number 4.

3. ESCUTCHEONS:

- A. Heavy type, chrome plated, with set screws. Provide for piping serving plumbing fixtures and at each wall, ceiling and floor penetrations in exposed finished locations and within cabinets and millwork.

4. CARRIERS:

- A. ASME/ANSI A112.6.1M, with adjustable gasket faceplate chair carriers for wall hung closets with auxiliary anchor foot assembly, hanger rod support feet, and rear anchor tie down.
- B. ASME/ANSI A112.6.1M, lavatory, chair carrier for thin wall construction. All lavatory chair carriers shall be capable of supporting the lavatory with a 250-pound vertical load applied at the front of the fixture.
- C. Where water closets, lavatories or sinks are installed back-to-back and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers. The drainage fitting of the back to back carrier shall be so constructed that it prevents the discharge from one fixture from flowing into the opposite fixture.

PART 3 - EXECUTION

1. INSPECTION:

- A. Review millwork shop drawings. Confirm the location and size of the fixtures and opening prior to rough-on and installation.

2. INSTALLATION:

- A. Fixture Setting: Opening between fixture and floor and wall finish shall be sealed.

- B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls and related finish surfaces. Exposed heads of bolts and nuts in finished rooms shall be hexagonal, polished chrome plated brass with rounded tops.
 - C. Furnish and install a cast brass trap at each fixture. Trap shall have removable cleanout.
 - D. Toggle Bolts: For hollow masonry units, finished or unfinished.
 - E. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 1/4 inch diameter bolts, and to extend at least 3 inches into masonry and be fitted with loose tubing or sleeves extending into masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.
 - F. Power Set Fasteners: May be used for concrete walls, shall be 1/4 inch threaded studs, and shall extend at least 1 1/4 inches into wall.
 - G. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.
 - H. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.
 - I. Furnish and install chrome plated stops with rigid supplies to fixtures. All stops to have renewable seats and disks, loose keys, reducers and escutcheons.
 - J. This contractor is responsible to assemble and install all plumbing fixtures whether or not furnished by this contractor.
 - K. Install all handicapped ADA fixtures per ANSI A117.1. Install pre-manufactured insulation covers for all sink and lavatory drains.
3. ADJUSTING AND CLEANING:
- A. At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.
 - B. Adjust stops and valves at each fixture to establish intended flow rates and to prevent splashing, noise, or overflow.

End of Section

SECTION 22 70 00
FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1. DESCRIPTION

Fuel gas systems, including piping, equipment and all necessary accessories as designated in this section.

2. SUBMITTALS

- A. Submit in accordance with GENERAL CONDITIONS and SUPPLEMENTARY GENERAL CONDITIONS.
- B. Manufacturer's Literature and Data:
 - 1) Pipe & Fittings.
 - 2) Valves.
 - 3) Accessories.
 - 4) All items listed in Part 2 - Products.

3. DELIVERY, STORAGE AND MATERIAL HANDLING

- A. Protect material at all times from weather and contamination on working surfaces. Clean or replace as required prior to installation. Keep piping ends plugged / capped until installation.

PART 2 - PRODUCTS

1. BELOW GRADE FUEL GAS SERVICE CONNECTIONS TO BUILDING

- A. From inside face of exterior wall to a distance of approximately 5 feet outside of building, use coated piping.
- B. Pipe: Black steel, ASTM A53, Schedule 40. Shop-applied pipe coating shall be one of the following types:

- 1) Coal Tar Enamel Coating: Exterior of pipe and fittings shall be cleaned, primed with Type B primer and coated with hot-applied coal tar enamel with bonded layer of felt wrap in accordance with AWWA C203. Asbestos felt shall not be used; felt material shall be fibrous glass mat as specified in Appendix Section A2.1 of AWWA C203.

C. Fittings:

- 1) Butt weld fittings, wrought steel, ANSI B16.9.
- 2) 2" and larger shall be socket weld, smaller than 2" shall be threaded fittings forged steel, ANSI B16.11.

2. ABOVE-GRADE FUEL GAS PIPING

A. Pipe: Black steel, ASTM A53, Schedule 40.

B. Nipples: Steel, ASTM A733, Schedule 40.

C. Fittings:

- 1) Sizes 2 inch and under ANSI B 16.3 threaded malleable iron.
- 2) Over 2 inch and up to 4 inch ANSI B16.11 socket welded.
- 3) Over 4 inch ANSI 16.9 butt welded.

D. Joints: Provide welded or threaded joints.

E. Unions 2" and smaller shall be 150 PSIG WOG, malleable iron, screwed with composition seat.

F. Flanges 2-1/2" and larger shall be 150 PSIG WOG, flat face, welded neck,

G. Paint exposed piping in interior finished spaces and weather exposures per requirements in General Conditions and Basic Plumbing / Mechanical Requirements

3. VALVES

A. Ball Valve: Bronze body, rated for 150 psi at 365°F, reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends, UL-listed for natural or LP gas shut off service when used on those services.

B. Automatic Shutoff Valve: Normally closed with manual reset solenoid. Valve shall have open indicator with auxiliary switches and terminal block, UL Listed for gas service. Coordinate the location and power wiring with the Electrical Contractor. Valve shall be compatible with related HVAC and Kitchen equipment.

4. PRESSURE REGULATORS

- A. Furnish and install regulators as required and shown on the plans to maintain required gas flow and supply pressure. Regulators shall be sized to provide the maximum flow at the highest appliance supply pressure required. Select the regulator spring in the center of the working pressure curve. Provide spare springs for adjustment up and down one step. Verify orifice is proper size for capacity, flow and pressure requirements.
- B. Mount the regulator per the manufacturer's requirements; vent the diaphragm to the exterior per IFGC and Manufacturer's requirements.
- C. Regulator shall be Maxon or approved equal.

5. DIELECTRIC FITTINGS

- A. Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

6. GAS EQUIPMENT CONNECTORS

- A. Flexible connectors with teflon core, interlocked galvanized steel protective casing, AGA certified design.

PART 3 - EXECUTION

1. INSTALLATION

- A. General: Comply with the International Fuel Gas Code, local codes and the following:
 - 1) Install branch piping for fuel gas and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
 - 2) Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, shall be reamed to full size after cutting.
 - 3) All pipe runs shall be laid out to avoid interference with other work.
 - 4) Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible.

- 5) Install union and shut-off valve on pressure piping at connections to equipment.
- 6) Pipe Hangers, Supports and Accessories:
 - a) All piping shall be supported per the International Fuel Gas Code, Chapter No. 4. All pipe shall be run straight and parallel lines shall be grouped on the same trapeze hanger wherever possible.
 - b) Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with red lead or zinc Chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
 - c) Floor, Wall and Ceiling Plates, Supports, Hangers:
 - i. Solid or split unplated cast iron, chrome plated in finished areas.
 - ii. 2) All plates shall be provided with set screws.
 - iii. 3) Pipe Hangers: Height adjustable clevis type.
 - iv. 4) Adjustable Floor Rests and Base Flanges: Steel.
 - v. 5) Concrete Inserts: "Universal" or continuous slotted type.
 - vi. 6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 - vii. 7) Riser Clamps: Malleable iron or steel.
 - viii. 8) Rollers: Cast iron.
 - ix. 9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
 - x. 10) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories.
- 7) Install cast chrome plated escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- 8) Penetrations:
 - a) Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in FIRESTOPPING. Completely fill and seal clearances between piping and openings with the fire stopping materials.

- b) Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in JOINT SEALANTS.
- B. Piping shall conform to the following:
 - 1) Fuel Gas:
 - a) Entire fuel gas piping installation shall be in accordance with requirements of NFPA 54.
 - b) Provide fuel gas piping with accessible plugged 6" drip pockets at low points.
 - c) Install branch shut-off cocks at all appliances and equipment.

2. CLEANING OF SYSTEM AFTER INSTALLATION

- A. Clean all piping systems to remove all dirt, coatings and debris.

3. TESTS

- A. General: Test system either in its entirety or in sections after system is installed or cleaned.
- B. Test shall be made in accordance with Section 406 of the International Fuel Gas Code. The system shall be tested at a minimum of 1.5 times maximum working pressure, but not less than 3 psig gage).

END OF SECTION

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1. DEFINITIONS:

- A. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
- B. Option or optional: Contractor's choice of an alternate material or method.

2. RELATED WORK

- A. The requirements of this section relate to all Division 23 sections included with this project.

3. QUALITY ASSURANCE

- A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality commercial class products from manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in commercial HVAC systems.
- B. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.
- C. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.
 - 2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
 - 3. Conform to codes and standards listed in the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the Project Engineer.

4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
7. Asbestos products or equipment or materials containing asbestos shall not be used.

D. Equipment Service Organizations:

1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and have factory certified technicians on staff.

E. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.

F. Execution (Installation, Construction) Quality:

1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions, the contract drawings and specifications to the Project Engineer for resolution.
2. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.

4. WARRANTIES

- A. All equipment, materials and workmanship shall be warrantied against defect for a period of (1) year from the date of substantial completion. Warranties listed herein shall cover the costs associated with the repair or replacement of the defective item or system within a reasonable timeframe.
- B. Refrigeration compressors shall be warrantied against defect or failure for a period of (5) years from the date of substantial completion. This warranty shall cover the cost of all parts and labor during the warranty period and equipment shall be repaired or replaced at no cost to the owner in a reasonable timeframe.

5. DRAWINGS

- A. The drawings as included as a part of the construction document package are diagrammatic in nature. They are meant to convey design intent and are not meant to be absolute in their content. It shall be the responsibility of the installing contractor to ensure that all equipment, materials, components and labor are provided for a fully functional, code compliant system in accordance with the design intent. Should questions arise or additional clarity be required, the contractor shall issue an RFI in written format to the prime design professional. Written communication will be the only form of correspondence between the design and construction teams and will be the only format by which changes, modifications or clarifications will be formally issued and is the only means by which the construction documents will be modified.

6. SUBMITTALS

- A. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet the intent of the construction documents. Contractor to ensure that all manufacturer or code required clearances are maintained for all installed equipment. Submittals shall be made as a single submission no later than 45 days after award of construction contract and shall be reviewed and approved by the project General Contractor or CM prior to submitting for approval. Approval of shop drawings or submittals does not constitute an acceptance from the Design Team and does not modify the Contractor's responsibility to provide equipment, materials and workmanship in accordance with the intent of the construction documents. Further, approval does not modify the requirement for the contractor to provide equipment, materials and workmanship as indicated in the contract documents whether it is indicated or discovered in the submittal review process or not. Contractor shall be responsible for providing all equipment, materials and workmanship in accordance with the construction documents regardless of level of approval.
- B. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract documents. This contractor shall be responsible for the cost associated with all modifications required as a result of equipment or material substitutions. This shall include the cost associated with all electrical, plumbing, structural and architectural modifications required as a result of the substitution. The Architect and Engineer of Record shall be duly compensated for the cost associated with making these modifications and updating the construction drawings accordingly. Shop drawing or submittal approval does not relinquish the contractor from the responsibility of providing equipment, materials and workmanship in accordance with the general intent of the construction documents and in compliance with all codes and standards in effect at

the time of construction. In cases where there is confusion or there appears to be conflicting information contained within the construction documents, the Architect or Engineer of Record shall be consulted through the RFI process and shall make the final determination as to the intent of the construction documents. The contractor shall proceed with the construction process in accordance with the interpretation of the Architect or Project Engineer at no additional cost to the owner or project.

- C. Prior to submitting shop drawings for approval, contractor shall ensure that manufacturers or vendors of all equipment have each reviewed drawings and specifications and have jointly coordinated and properly integrated their equipment and controls to provide a complete, functional, efficient and code compliant installation in accordance with the intent of the construction documents.
- D. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible installation.
- E. Coordination Drawings:
 - 1. Prior to start of construction, General Contractor to host an all trade meeting to review their coordinated drawings. Submit complete coordinated layout drawings for all new systems to Project Engineer to review. Coordination drawings shall include all relevant building systems necessary to demonstrate a coordinated installation. This shall include all HVAC, electrical, plumbing, structural, architectural and low voltage systems scheduled for installation or modification. Failure for the contractor to submit the required coordination drawings shall indicate that the contractor has taken full responsibility for the cross-discipline coordination effort and is proceeding completely at his own risk. Should the Architect, Engineer or Authority Having Jurisdiction identify any installation, functional, clearance or compliance issues during field observations, the contractor shall provide for remedy of the identified issues completely at his own cost.
 - 2. The coordination drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1/4 inch per foot. Clearly identify and dimension the proposed locations of the principal items of equipment and building systems. The drawings shall clearly show locations and adequate clearance for all equipment, piping, ducting, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed layout drawings of all piping and duct systems to include all materials, fittings, elbows, access doors, accessories, dampers, control elements, etc.
 - 3. Do not install equipment foundations, equipment or piping until layout drawings have been approved.
 - 4. In addition, for HVAC systems, provide details of the following:
 - a) Mechanical equipment rooms.
 - b) Hangers, inserts, supports, and bracing.
 - c) Pipe sleeves.

- d) Duct or equipment penetrations of floors, walls, ceilings, or roofs.
- F. HVAC Maintenance Data and Operating Instructions:
 - 1. Maintenance and operating manuals shall be provided with the project close-out documents.
 - 2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style.
 - 3. Close-out documentation shall be provided to the owner at the completion of the project. Close-out documentation shall be completely contained within a binder or series of binders and shall include the approved submittals, test & balance report, manufacturer provided O&M manuals, as-built drawings, start-up reports, warranty registrations, warranty contact information, maintenance/repair contact information and complete operating instructions. In addition to the required binders, a complete copy of the close-out documents shall be provided in PDF format on DVD. Unless otherwise noted in the front-end documents or as requested by the owner, a total of (3) sets of close-out documents shall be provided at the completion of the construction process.
- G. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.
- H. As-built documents shall be prepared using the latest versions of either AutoCAD or REVIT (depending on the software used in the design process) and shall indicate any modifications made during the construction process. An electronic copy of all as-built drawings shall be provided to the Design Team in either (.dwg) format or (.rvt) format upon completion. Both full size printed copies and electronic copies of the as-built drawings shall be provided with the close-out document package. Electronic files shall be stored on DVD and shall be provided with the project close-out documents and shall be provided in PDF format.
- I. All close-out documents must be received by the owner and electronic files received by the Design Team prior to approval and release of the final pay-application.
- J. APPLICABLE CODES AND STANDARDS
 - 1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
 - 2. Air Conditioning, Heating and Refrigeration Institute (AHRI)
 - 3. American National Standard Institute (ANSI)
 - 4. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - 5. National Fire Protection Association (NFPA)

6. Kentucky Building Code and all International Building Code (IBC) suites adopted by reference and all relevant sections.

7. All enforced local codes, standards and amendments.

K. DELIVERY, STORAGE AND HANDLING

1. Protection of Equipment:

- a) Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
- b) Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Resident Engineer. Such repair or replacement shall be at no additional cost to the owner.
- c) Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
- d) Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as necessary for new work.

L. Cleanliness of Piping and Equipment Systems:

- 1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
- 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
- 3. Clean interior of all tanks prior to delivery for beneficial use by the owner.
- 4. Boilers shall be left clean following final internal inspection by owner insurance representative or inspector.
- 5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

PART 2 - PRODUCTS

1. FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components to reduce spare part requirements.

- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
 - C. All components of an assembled unit need not be products of same manufacturer.
 - 1. Constituent parts that are alike shall be products of a single manufacturer.
 - 2. Components shall be compatible with each other and with the total assembly for intended service.
 - 3. Contractor shall guarantee performance of assemblies of components and shall repair or replace elements of the assemblies to deliver specified performance of the complete assembly.
 - D. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
 - E. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.
2. COMPATIBILITY OF RELATED EQUIPMENT
- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.
3. ELECTRIC MOTORS
- A. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS and the associated electrical sections. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors.
 - B. Variable speed motor controllers
 - 1. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. air handlers, fans, pumps, shall be product of a single manufacturer.
 - 2. Motors shall be premium efficiency type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor fan sheaves shall be fixed pitch.

3. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the AC power system.
4. Controller shall be provided with the following operating features and accessories:
 - a) Suitable for variable torque load.
 - b) Provide thermal magnetic circuit breaker with external operator and incoming line fuses. Unit shall be rated for minimum 30,000 AIC. Provide AC input line reactors (3% Impedance) on incoming power line. Provide output line reactors on line between drive and motor for motors over 50 HP or where the distance between the breaker and motor exceeds 50 feet.

4. EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 3/16-inch high of brass with black-filled letters, or rigid black plastic with white letters permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 3/16-inch high riveted or bolted to the equipment.
- D. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
 1. Valve tags: Engraved black filled numbers and letters not less than 1/2-inch high for number designation, and not less than 1/4-inch for service designation on 19 gage 1-1/2 inches round brass disc, attached with brass "S" hook or brass chain.
 - a) Valve lists: Typed or printed plastic coated card(s), sized 8-1/2 inches by 11 inches showing tag number, valve function and area of control, for each service or system.
 - b) Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color coded thumb tack in ceiling.

5. HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. Supports for Piping Systems:

1. Select hangers sized to encircle insulation on insulated piping. Refer to Mechanical Insulation spec section for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
- B. Piping Systems except High and Medium Pressure Steam (MSS SP-58):
1. Standard clevis hanger: Type 1; provide locknut.
 2. Riser clamps: Type 8.
 3. Wall brackets: Types 31, 32 or 33.
 4. Roller supports: Type 41, 43, 44 and 46.
 5. Saddle support: Type 36, 37 or 38.
 6. Turnbuckle: Types 13 or 15. Preinsulate.
 7. U-bolt clamp: Type 24.
 8. Copper Tube:
 - a) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non adhesive isolation tape to prevent electrolysis.
 - b) For vertical runs use epoxy painted or plastic coated riser clamps.
 - c) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
 - d) Insulated Lines: Provide pre-insulated shields sized for copper tube.
 - e) Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.
6. PIPE PENETRATIONS
- A. Install sleeves during construction for other than blocked out floor openings for risers.
- B. To prevent accidental liquid spills from passing to a lower level, provide the following:
1. For sleeves: Extend sleeve one inch above finished floor and provide sealant for watertight joint.

2. For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
3. For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
4. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of the Architect.
5. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
6. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
7. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.
8. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

7. DUCT PENETRATIONS

- A. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 18 inches high with continuously welded seams, built-in cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.
- B. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly.

8. WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

9. ASBESTOS

- A. Materials containing asbestos are not permitted.

PART 3 - EXECUTION

1. ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment with other trades. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, lights and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors and control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.
- C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Cutting Holes:
 - 1. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance for coordination purposes. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to the Architect or Structural Engineer for approval.
 - 2. Do not penetrate membrane waterproofing.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical interconnections are not shown but must be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. Electrical Interconnection of Controls and Instruments: This is generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- I. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations. Damaged or defective items, in the opinion of the Architect or Project Engineer, shall be replaced.
 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
 - J. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
 - K. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical equipment. If this is not possible, encase pipe in a second pipe with a minimum of joints and provide a baffle above the electrical equipment sloped to ensure water will run-off away from the electrical equipment. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall be located in the space equal to the width and depth of the equipment and extending from to a height of 6 ft. above the equipment or to the ceiling structure, whichever is lower (NFPA 70).
 - L. Inaccessible Equipment:
 1. Equipment shall be installed with access clearance and access service panels necessitated by section 306 of the International Mechanical Code (referenced by the Kentucky Building Code), National Electric Code and manufacturer's instructions, whichever is the most stringent. Equipment access shall be provided so that equipment may be removed without removing elements of permanent construction (gypsum board ceilings, plumbing piping, etc.). Contractor to include hard ceiling access panel in its price. Coordinate panel size and location with architect.
 2. Where the Architect or Project Engineer determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the owner.
 3. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.
2. TEMPORARY SYSTEMS AND EQUIPMENT
- A. Where required by the construction documents, temporary systems shall be provided to match the capacity of the systems being modified to ensure continuous operations of the space. Temporary systems shall be capable of maintaining the spaces temperature and humidity at levels acceptable to the owner.

- B. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.
- C. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress and shall be insulated where injury can occur to personnel by contact with operating facilities.
- D. Temporary facilities and piping shall be completely removed and any openings in structures sealed/finished to match existing. Provide necessary blind flanges and caps to seal open piping remaining in service.

3. RIGGING

- A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by the owner under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.
- C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for owner operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.
- E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Restore building and surroundings to original condition upon completion of rigging work.

4. PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the Architect or Structural Engineer.
- B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.
- C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 1/2-inch clearance between pipe or piping covering and adjacent work.

- D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69 and relevant codes. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.
 - E. HVAC Vertical Pipe Supports:
 - 1. Up to 6-inch pipe, 30 feet long, bolt riser clamps to the pipe below couplings or welded to the pipe and rests supports securely on the building structure.
 - 2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.
 - F. Overhead Supports:
 - 1. Contractor shall confirm that the basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
 - 2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
 - G. Floor Supports:
 - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating conditions, seismic conditions (if applicable), and to withstand design wind pressures without excessive displacement or structural failure.
 - 2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment plus 3 inch excess on all edges. Boiler foundations shall have horizontal dimensions that exceed boiler base frame dimensions by at least 6 inches on all sides. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
 - 3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.
5. CLEANING AND PAINTING
- A. Prior to final inspection and acceptance of the facilities for beneficial use by the owner, the facilities, equipment and systems shall be thoroughly cleaned and painted.
 - B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
- C. Material And Equipment Not To Be Painted Includes:
1. Motors, controllers, control switches, and safety switches.
 2. Control and interlock devices.
 3. Regulators.
 4. Pressure reducing valves.
 5. Control valves and thermostatic elements.
 6. Lubrication devices and grease fittings.
 7. Copper, brass, aluminum, stainless steel and bronze surfaces.
 8. Valve stems and rotating shafts.
 9. Pressure gauges and thermometers.
 10. Glass.
 11. Name plates.
- D. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
- E. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
- F. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
- G. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.
- H. Any exposed piping, ducting or equipment shall be completely painted. Colors shall be consistent with industry standards or as the owner wishes. All exterior equipment, piping or ducting shall be painted with a corrosion resistant finish compatible with the painted material and as recommended by the manufacturer.
6. MOTOR AND DRIVE ALIGNMENT

- A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane. Provide belt and sheave replacements required to achieve test and balance at no additional cost to project.
- B. Direct-connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

7. LUBRICATION

- A. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.
- B. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

8. STARTUP AND TEMPORARY OPERATION

- A. Start-up equipment as described in equipment specifications. All HVAC equipment shall be provided with factory start-up performed by the equipment manufacturer. Start-up sheets shall be included with the close-out documentation. Verify that vibration is within specified tolerance prior to extended operation.

9. OPERATING AND PERFORMANCE TESTS (If Required)

- A. Should evidence of malfunction in any tested system or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the owner.
- B. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made prior to performance tests, performance tests for heating and cooling systems shall be completed during first actual seasonal use of respective systems following completion of work.

End of Section

SECTION 23 05 12 - GENERAL MOTOR REQUIREMENTS

PART 1 - GENERAL

1. DESCRIPTION:

- A. This section specifies the furnishing, installation and connection of motors for all HVAC, plumbing and fire protection equipment.

2. SUBMITTALS:

A. Shop Drawings:

1. Provide documentation to demonstrate compliance with drawings and specifications.
2. Include electrical ratings, efficiency, bearing data, power factor, frame size, dimensions, mounting details, materials, horsepower, voltage, phase, speed (RPM), enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.

B. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete installation, maintenance and operating manuals, including technical data sheets and application data.

PART 2 - PRODUCTS

1. MOTORS:

- A. For alternating current, fractional and integral horsepower motors, NEMA Publications MG 1 and MG 2 shall apply.
- B. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide premium efficiency type motors as scheduled. unless otherwise specified for a particular application, use electric motors with the following requirements.
- C. Single-phase Motors: Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC) type. Provide capacitor-start type for hard starting applications.
 1. Electrically Commutated motor (ECM Type): Motor shall be brushless DC type specifically designed for applications with heavy duty ball bearings and electronic commutation. The motor shall be speed controllable down to 20% of full speed and 85% efficient at all speeds.
- D. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type.

1. Two Speed Motors: Each two-speed motor shall have two separate windings. Provide a time-delay (20 seconds minimum) relay for switching from high to low speed.
- E. Motors shall be designed for operating the connected loads continuously in a 40°C (104°F) environment, where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation. If the motors exceed 40°C (104°F), the motors shall be rated for the actual ambient temperatures.
- F. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque.
- G. Motor Enclosures:
1. Shall be the NEMA types as specified and/or shown on the drawings.
 2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types, which are most suitable for the environmental conditions where the motors are being installed. Enclosure requirements for certain conditions are as follows:
 - a. Motors located outdoors, indoors in wet or high humidity locations, or in unfiltered airstreams shall be totally enclosed type.
 - b. Where motors are located in an NEC 511 classified area or in areas with explosive materials, provide TEFC explosion proof motor enclosures.
 - c. Where motors are located in a corrosive environment, provide TEFC enclosures with corrosion resistant finish.
 3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.
- H. Special Requirements:
1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the owner.
 2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification and the manufacturer's written installation material.
 3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
 - a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.
 - b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.
 - c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.

4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on all HVAC, plumbing and fire equipment shall be sized for non-overloading at all points on the performance curves.
 5. Motors utilized with variable frequency drives shall be rated "inverter-duty" per NEMA Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.
- I. Energy-Efficient Motors (Motor Efficiencies): All permanently wired motors of (1) HP or more shall meet the minimum full-load efficiencies as indicated in the following table. Motors of (1) HP or more with open, drip-proof or totally enclosed fan-cooled enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors not specified as "premium efficiency" shall comply with the Energy Policy Act of 2005 (EPACT).

Minimum Premium Efficiencies Open Drip-Proof				Minimum Premium Efficiencies Totally Enclosed Fan-Cooled			
Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM	Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%
37.3 (50)	94.1%	94.5%	93.0%	37.3 (50)	94.1%	94.5%	93.0%
44.8 (60)	94.5%	95.0%	93.6%	44.8 (60)	94.5%	95.0%	93.6%
56.9 (75)	94.5%	95.0%	93.6%	56.9 (75)	94.5%	95.4%	93.6%
74.6 (100)	95.0%	95.4%	93.6%	74.6 (100)	95.0%	95.4%	94.1%
93.3 (125)	95.0%	95.4%	94.1%	93.3 (125)	95.0%	95.4%	95.0%
112 (150)	95.4%	95.8%	94.1%	112 (150)	95.8%	95.8%	95.0%
149.2 (200)	95.4%	95.8%	95.0%	149.2 (200)	95.8%	96.2%	95.4%

- J. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM and 3600 RPM.

PART 3 – EXECUTION

1. INSTALLATION:

- A. Install motors in accordance with manufacturer's recommendations, the NEC, NEMA, as shown on the drawings and/or where necessitated by other sections of these specifications.

2. FIELD TESTS:

- A. Perform an electric insulation resistance test using a megohmmeter on all motors after installation, before start-up. All shall test free from grounds.

- B. Perform Load test in accordance with ANSI/IEEE 112, Test Method B, to determine freedom from electrical or mechanical defects and compliance with performance data.
- C. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

End of Section

SECTION 23 05 90 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1. DESCRIPTION:

- A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:

1. Planning systematic TAB procedures.
2. Design Review Report.
3. Systems Inspection report.
4. Duct Air Leakage test report.
5. Systems Readiness Report.
6. Balancing air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
7. Recording and reporting results.

B. Definitions:

1. Basic TAB used in this Section: Chapter 37, "Testing, Adjusting and Balancing" of 2007 ASHRAE Handbook, "HVAC Applications".
2. AABC: Associated Air Balance Council.
3. NEBB: National Environmental Balancing Bureau.
4. Hydronic Systems: Includes domestic hot water circulating systems and any pumped domestic water supply systems.
5. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems. Note: Test and balance of all systems is a requirement of this project.

2. QUALITY ASSURANCE:

A. Qualifications:

1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
2. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified

herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the Architect and submit another TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding contract award shall not be eligible to perform any work related to the TAB. All work performed in this section and in other related sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.

3. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the Architect and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding contract award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this section and in other related sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to contract completion and must be performed by an approved successor.
4. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information by the Resident Engineer. The responsibilities would specifically include:
 - a. Shall directly supervise all TAB work.
 - b. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC or NEBB.
 - c. Would follow all TAB work through its satisfactory completion.
 - d. Shall provide final markings of settings of all HVAC adjustment devices.
 - e. Permanently mark location of duct test ports.
5. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing. The lead technician shall be certified by AABC or NEBB.
6. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.
7. Tab Criteria:
 - a. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by ASHRAE Handbook "HVAC Applications" Chapter 36, and

requirements stated herein shall be the basis for planning, procedures, and reports.

- b. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36, as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 100 percent of manufacturer recommended change over pressure drop values for pre-filters and after-filters.
- c. Air handling unit and all other fans, (cubic feet per minute): Minus 0 percent to plus 10 percent.
- d. Minimum outside air: 0 percent to plus 10 percent.
- e. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 5 percent to plus 10 percent except if the air to a space is 100 CFM or less the tolerance would be minus 5 to plus 5 percent.
- f. Domestic water circulation and booster systems: Minus 5 percent to plus 5 percent.

3. SUBMITTALS

- A. Submit names and qualifications of TAB agency and TAB specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment with calibration reports.
- B. Submit Following for Review and Approval:
 - 1. Design Review Report within 90 days for conventional design projects and within 60 days for design-build projects.
 - 2. Systems inspection report on equipment and installation for conformance with design.
 - 3. Duct Air Leakage Test Report.
 - 4. Systems Readiness Report.
 - 5. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
 - 6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.
- C. Prior to request for Final or Substantial Completion inspection, submit completed Test and Balance report for the area.

4. APPLICABLE PUBLICATIONS:

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE): 2007 HVAC Applications ASHRAE Handbook, Chapter 37, Testing, Adjusting, and Balancing and Chapter 47, Sound and Vibration Control.
- C. Associated Air Balance Council (AABC): 2002 AABC National Standards for Total System Balance.
- D. National Environmental Balancing Bureau (NEBB):
7th Edition 2005 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems. 2nd Edition 2006 Procedural Standards for the Measurement of Sound and Vibration. 3rd Edition 2009 Procedural Standards for Whole Building Systems Commissioning of New Construction.
- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
3rd Edition 2002 HVAC SYSTEMS Testing, Adjusting and Balancing.

PART 2 – PRODUCTS

1. PLUGS:

- A. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

PART 3 – EXECUTION

1. GENERAL:

- A. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

2. DESIGN REVIEW REPORT:

- A. The TAB Specialist shall review the Contract Plans and specifications and advise the Architect of any design deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3. SYSTEMS INSPECTION REPORT:

- A. Inspect equipment and installation for conformance with design.
- B. The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.

- C. Reports: Follow check list format developed by AABC, NEBB or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

4. DUCT AIR LEAKAGE TEST REPORT:

TAB Agency shall perform the leakage test as outlined in the duct system specification for agency's role and responsibilities in witnessing, recording and reporting of deficiencies.

5. SYSTEM READINESS REPORT:

- A. The TAB Contractor shall measure existing air and water flow rates associated with existing systems utilized to serve renovated areas as indicated on drawings. Submit report of findings to Architect
- B. Inspect each system to ensure that it is complete including installation and operation of controls. Submit report to Architect in standard format and forms prepared and or approved by the Commissioning Agent if applicable.
- C. Verify that all items such as ductwork, piping, ports, terminals, connectors, etc., that are required for TAB are installed. Provide a report to the Architect.

6. TAB REPORTS:

- A. Submit an intermediate report for 25 percent of systems and equipment tested and balanced to establish satisfactory test results.
- B. The TAB contractor shall provide raw data in writing to the Architect if there is a problem in achieving intended results before submitting a formal report.
- C. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated and re-submitted for approval at no additional cost to the owner.
- D. Do not proceed with the remaining systems until intermediate report is approved by the Architect.

7. TAB PROCEDURES:

- A. Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.
- B. General: During TAB, all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

- C. Coordinate TAB procedures with existing systems and any phased construction completion requirements for the project. Provide TAB reports for pre-construction air and water flow rate and for each phase of the project prior to partial final inspections of each phase of the project. Return existing areas outside the work area to pre constructed conditions.
- D. Air Balance and Equipment Test: Include air handling units, fans, fan coil units, and room diffusers/outlets/inlets. Include all supply, return and exhaust systems as well as outdoor air systems. Kitchen range hood systems shall be balanced as well.
 - 1. Artificially load air filters by partial blanking to produce air pressure drop of manufacturer's recommended pressure drop.
 - 2. Adjust fan speeds to provide design air flow. Provide for belt and sheave replacements to achieve design flow rates.
 - 3. Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other controls function properly.

8. MARKING OF SETTINGS:

- A. Following approval of Tab final Report, the setting of all HVAC adjustment devices including valves and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be high contrast in color and permanent.

9. IDENTIFICATION OF TEST PORTS:

- A. The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

10. PHASING:

- A. Phased Projects: Testing and Balancing Work to follow project with areas shall be completed per the project phasing. Upon completion of the project all areas shall have been tested and balanced per the contract documents.

End of Section

SECTION 23 07 10 - MECHANICAL INSULATION

PART 1 – GENERAL

1. DESCRIPTION:

- A. Field applied insulation for thermal efficiency and condensation control for HVAC piping, ductwork and equipment.
- B. Definitions:
 - 1. ASJ: All service jacket, white finish facing or jacket.
 - 2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
 - 3. Cold: Equipment, ductwork or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
 - 4. Concealed: Ductwork and piping above ceilings and in chases, interstitial space, and pipe spaces.
 - 5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including equipment rooms or exposed to outdoor weather. Shafts, chases, interstitial spaces, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
 - 6. FSK: Foil-scrim-kraft facing.
 - 7. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.

2. QUALITY ASSURANCE:

- A. Criteria:
- B. Comply with NFPA 90A, SMACNA, ASHRAE and the codes in effect at the time of permitting.
- C. Test methods: ASTM E84, UL 723, or NFPA 255.
- D. Specified k factors are at 75 degrees F mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

- E. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.
- F. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.
- G. Where system components or equipment are found to be producing condensation, contractor shall re-insulate or add additional insulation to prohibit the formation of condensation.

3. SUBMITTALS:

A. Shop Drawings:

- 1. All information, clearly presented, shall be included to determine compliance with drawings and specifications
- 2. Insulation materials: Specify each type used and state surface burning characteristics.
- 3. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
- 4. Insulation accessory materials: Each type used.
- 5. Make reference to applicable specification paragraph numbers for coordination.

4. STORAGE AND HANDLING OF MATERIAL:

- A. Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions by printed instructions of manufacturers of adhesives, mastics and finishing cements.

PART 2 - PRODUCTS

1. MINERAL FIBER OR FIBER GLASS (INTERIOR):

- A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m³ (3 pcf), k = 0.037 (0.26) at 24 degrees C (75 degrees F), external insulation for temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing. Seams sealed with pressure sensitive tape and mastic. Provide with anti-microbial coating on interior surfaces.
- B. ASTM C553 (Blanket, Flexible) Type I, Class B-5, Density 32 kg/m³ (2 pcf), k = 0.04 (0.27) at 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing. Seams sealed with pressure sensitive tape and mastic.
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (450 degrees F) with an all service vapor retarder jacket with polyvinyl chloride pre-molded fitting covering.

2. CELLULAR GLASS CLOSED-CELL:

- A. Comply with Standard ASTM C177, C518, density 120 kg/m³ (7.5 pcf) nominal, $k = 0.033$ (0.29) at 240 degrees C (75 degrees F).
- B. Pipe insulation for use at temperatures up to 200 degrees C (400 degrees F) with all service vapor retarder jacket.

3. FLEXIBLE ELASTOMERIC CELLULAR THERMAL:

- A. ASTM C177, C518, $k = 0.039$ (0.27) at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No jacket required. Seal seams with adhesive and tape.

4. INSULATION FACINGS AND JACKETS:

- A. Vapor Retarder, high strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75 mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.
- D. Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping and ductwork as well as on interior piping and ductwork exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity areas conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.
- E. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.
- F. Aluminum Jacket-Piping systems and circular breeching and stacks: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same

construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 13 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.

5. PIPE COVERING PROTECTION SADDLES:

- A. Pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass insulation of the same thickness as adjacent insulation.

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long
200 (8), 250 (10), 300 (12)	225 (9) long
350 (14), 400 (16)	300 (12) long
450 through 600 (18 through 24)	350 (14) long

6. ADHESIVE, MASTIC, CEMENT:

- A. As recommended by insulation manufacturers' published recommendations.

7. MECHANICAL FASTENERS:

- A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching galvanized steel.
- C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.
- D. Bands: 13 mm (0.5 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

8. REINFORCEMENT AND FINISHES:

- A. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
- B. PVC fitting cover: Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Provide color matching vapor barrier pressure sensitive tape.

9. FLAME AND SMOKE:

- A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications.

PART 3 – EXECUTION

1. GENERAL REQUIREMENTS:

- A. Pressure tests of duct and piping joints and connections shall be completed. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems. Lap and seal vapor retarder over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- E. Construct insulation on parts of equipment such as chilled water pumps and heads of chillers, convertors and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.
- F. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- G. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable. Duct systems shall be tented on the top surface to ensure positive drainage of water from the surface.
- H. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- I. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow and fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting.
- J. Firestop Pipe and Duct insulation: Provide firestopping insulation at fire and smoke barriers through penetrations. All penetrations through rated assemblies will require fire stopping with a U.L. approved firestopping method.

- K. Freeze protection of above grade outdoor piping (over heat tracing tape): 1.5" thick cellular glass insulation for all pipe sizes. Provide metal jackets for all pipes.
- L. Provide vapor barrier jackets over insulation as follows: All piping and duct systems shall be provided with an integral vapor barrier unless noted otherwise.
- M. Provide metal jackets over insulation as follows: All piping and ducts exposed to the outdoors, all piping in mechanical equipment rooms, all piping exposed in building. Jackets may be applied with pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling or floor penetrations. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

2. INSULATION INSTALLATION:

- A. Mineral Fiber Board and Rigid Duct Board: Apply board on pins spaced not more than 300 mm (12 inches) on center each way, and not less than 75 mm (3 inches) from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.
- B. Flexible Mineral Fiber Blanket: Adhere insulation to metal with 75 mm (3 inch) wide strips of insulation bonding adhesive at 200 mm (8 inches) on center all around duct. Additionally secure insulation to bottom of ducts exceeding 600 mm (24 inches) in width with pins welded or adhered on 450 mm (18 inch) centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where applicable.
- C. Molded Mineral Fiber Pipe and Tubing Covering: Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on ducts and piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports.
- D. Cellular Glass Insulation: Pipe and tubing, covering nominal thickness as specified in the schedule at the end of this section. Install per manufacturer's instructions.
- E. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ for chilled water pumps, water filters, chemical feeder pots or tanks, expansion tanks, air separators and air purgers.
- F. Flexible Elastomeric Cellular Thermal Insulation: Apply insulation and fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
 - 1. Pipe and tubing insulation: Use proper size material. Do not stretch or strain insulation.
 - 2. Where possible, slip insulation over the pipe or tubing prior to connection and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.

3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.

3. INSULATION SCHEDULES:

A. Piping

SERVICE	PIPE SIZE	INSULATION TYPE AND THICKNESS
Refrigerant Suction Pipes and Coil Condensate Lines (except in plenums or fire wall penetrations)	All	1" Elastomeric
Refrigerant Suction Pipes and Coil Condensate Lines (in plenums or fire wall or floor penetrations)	1-1/4" or Less	1-1/2" Cellular Glass w/ ASJ
Refrigerant Suction Pipes and Coil Condensate Lines (in plenums or fire wall or floor penetrations)	1-1/4" or More	1-1/2" Cellular Glass w/ ASJ
Domestic Hot Water & Cold Water in Exterior walls, Tempered Water, Recirculated Hot Water, and Service Hot Water	2" or Less	R-3 Minimum
Sanitary P-Traps and associated 10 feet of downstream piping, Any Piping Exposed to Freezing Conditions	All	1-1/2" Miner Fiber w/ ASJ Raychem XL Self-regulating Heat Trace
Roof Drain Bodies	All	1-1/2" Mineral Fiber w/ ASJ
Horizontal Rain Water Conductors	All	1-1/2" Mineral Fiber w/ ASJ

B. Ducting

SERVICE	SIZE	INSULATION TYPE AND THICKNESS
Supply, Return and Outdoor Air Ductwork (Interior Concealed)	All	2" Thick Fiberglass Duct Wrap with Tape and Mastic Sealed Seams. R-6.0 Minimum.
Equipment Operating Under Dewpoint or Subject to Condensation	All	2" Thick Fiberglass Duct Wrap with Tape and Mastic Sealed Seams. R-6.0 Minimum.
Tops of Supply Air Diffusers	All	2" Thick Fiberglass Duct Wrap with Tape and Mastic Sealed Seams. R-6.0 Minimum.

End of Section

DOCUMENT 23 23 00 – REFRIGERANT PIPING

PART 1 - GENERAL

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.

2. SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

3. PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:

- 1. Suction Lines for Air-Conditioning Applications: 300 psig
- 2. Suction Lines for Heat-Pump Applications: 535 psig
- 3. Hot-Gas and Liquid Lines: 535 psig

4. ACTION SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated.
- B. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Thermostatic expansion valves.
 - 2. Solenoid valves.
 - 3. Hot-gas bypass valves.
 - 4. Filter dryers.
 - 5. Strainers.
 - 6. Pressure-regulating valves.
- C. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Shop Drawing Scale: 1/4 inch equals 1 foot

- D. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

5. INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control test reports.

C. CLOSEOUT SUBMITTALS

- 1. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

6. QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

7. PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

8. COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

1. Copper Tube: ASTM B 88, Type K or L.

- A. Wrought-Copper Fittings: ASME B16.22.

- B. Wrought-Copper Unions: ASME B16.22.

- A. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

B. Brazing Filler Metals: AWS A5.8.

C. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Pressure Rating: Factory test at minimum 500 psig
5. Maximum Operating Temperature: 250 deg F

3. VALVES AND SPECIALTIES

A. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig

C. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F
6. Superheat: Adjustable
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig

D. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.

2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig
5. Maximum Operating Temperature: 275 deg F

E. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig
7. Maximum Operating Temperature: 240 deg F

F. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
1. Designed for reverse flow (for heat-pump applications).
2. End Connections: Socket.
1. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
2. Maximum Pressure Loss: 2 psig
3. Working Pressure Rating: 500 psig
4. Maximum Operating Temperature: 240 deg F

C. Port Caps:

1. Provide tamper-resistant, locking-type, access port caps on all piping ports located outside.

5. REFRIGERANTS

B. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.
5. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

1. 3.02 VALVE AND SPECIALTY APPLICATIONS

- A. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- B. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- C. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- D. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- E. Install thermostatic expansion valves as close as possible to distributors on evaporators.
1. Install valve so diaphragm case is warmer than bulb.
 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- F. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- G. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

H. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

I. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

J. Install receivers sized to accommodate pump-down charge.

K. Install flexible connectors at compressors.

2. PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 2. Install horizontal suction lines with a uniform slope downward to compressor.
 1. Install traps and double risers to entrain oil in vertical runs.
 - a. Liquid lines may be installed level.
 2. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
 1. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
 2. Identify refrigerant piping and valves according to Common Work Results for HVAC, Section 23 05 00.
 3. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Common Work Results for HVAC, Section 23 05 00.
 1. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Common Work Results for HVAC, Section 23 05 00.

2. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Common Work Results for HVAC, Section 23 05 00.

5. PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- E. Welded Joints: Construct joints according to AWS D10.12/D10.12M.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

6. FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.

c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.

d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

7. SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

8. ADJUSTING

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

D. Adjust set-point temperature of air-conditioning controllers to the system design temperature.

E. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

F. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 00 - HVAC DUCTS

PART 1 – GENERAL

1. DESCRIPTION

A. Ductwork and accessories for HVAC including the following:

1. Supply air, return air, outside air, exhaust, make-up air, and relief systems.

B. Definitions:

1. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
2. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
3. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
4. Exposed Duct: Exposed to view in a finished room, exposed to weather.

2. QUALITY ASSURANCE

A. Fire Safety Code: Comply with NFPA 90A.

B. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.

C. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes.

D. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

3. SUBMITTALS

A. Submit in accordance with section requirements. Provided detailed shop drawings of duct system coordinated with building structure and other trades. No work on the duct systems shall commence until duct system shop drawings have been submitted to Project Engineer for review. Any work completed prior to duct system shop drawing review shall be at the risk of the contractor and shall be subject to modification or removal where required by the Project Architect or Engineer.

B. Manufacturer's Literature and Data:

1. Rectangular ducts:

- a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.
 - b. Duct liner.
 - c. Sealants and gaskets.
 - d. Access doors.
2. Round and flat oval duct construction details:
 - a. Manufacturer's details for duct fittings.
 - b. Duct liner.
 - c. Sealants and gaskets.
 - d. Access sections.
 - e. Installation instructions.
3. Volume dampers, back draft dampers.
4. Upper hanger attachments and duct support systems.
5. Fire dampers, fire doors, and smoke dampers with installation instructions.
6. Sound attenuators, including pressure drop and acoustic performance.
7. Flexible ducts and clamps, with manufacturer's installation instructions.
8. Flexible connections.
9. Instrument test fittings.
10. Details and design analysis of alternate or optional duct systems.

PART 2 - PRODUCTS

1. DUCT MATERIALS AND SEALANTS

- A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A653, G90 galvanizing. Duct sheet metal thickness shall be in accordance with the SMACNA Duct Construction Manual.
- B. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards for recommended seal class.

1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer.
2. Gaskets in Flanged Joints: Soft neoprene. Approved factory made joints may be used.

2. DUCT CONSTRUCTION AND INSTALLATION

- A. Duct installation methods, supports and other pertinent installation criteria shall be as indicated in the SMACNA Duct Construction Standards and SMACNA Duct Installation manuals.
- B. Seal Class: All ductwork shall be sealed to Seal Class C.
- C. Round and Flat Oval Ducts: Furnish duct and fittings made by the same manufacturer to insure good fit of slip joints. When submitted and approved in advance, round and flat oval duct, with size converted on the basis of equal pressure drop, may be furnished in lieu of rectangular duct design shown on the drawings.
 1. Elbows: Diameters 3 through 8 inches shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.
 2. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards.
 3. Casings and Plenums: Construct in accordance with SMACNA HVAC Duct Construction Standards Access doors shall be hollow metal, insulated, with latches and door pulls. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain or to exterior of building.
- D. Rigid Fiberglass Duct Board (only for horizontal duct runs in apartments): ANSI/ASTM C612; commercial grade; 6.0 installed 'R' value (minimum) at 75 degrees F, foil scrim kraft facing for air conditioning ducts (nominally 1.5" thick). Not to be used in exposed locations. All seams shall be sealed air and vapor tight with pressure sensitive tape and mastic. Duct board shall be equal to Certainteed, Certapro Commercial Board with FSK facing, type CB 300 (3.0 lb/cu.ft.) minimum density. Vapor barrier shall be integral and continuous across seams. All fiberglass duct board shall be installed in accordance with NAIMA Standards.
- E. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Any dampers required to have a motorized damper shall be provided by the mechanical contractor as a complete system including the damper, actuator and linkage attachments. Actuators shall be as provided by Belimo. It shall be the responsibility of this contractor to provide all dampers and actuators necessary and these systems shall be coordinated with the controls contractor and electrical contractor accordingly for power or control requirements.
- F. FLEXIBLE DUCTS:
 1. Air Device Connection Ducts:
 - a. Flexible fiberglass duct with a maximum thermal conductivity of 0.24 BTU/HR - degrees F - Sq.Ft. at 75 degrees F mean temperature with a maximum flame spread rating of 25 and smoke developed rating of 50. Thickness shall be determined to meet the same

insulation level as the main duct system or the prevailing energy code. The duct shall conform to NFPA Standards and be listed by Underwriters Laboratories as 181 Class I Air Duct.

- b. On all branch duct connections to air devices, flexible fiberglass duct shall be provided with bellmouth fitting with integral volume damper and stainless steel hose clamp. Insulation shall be continuous and shall be securely connected to main duct insulation through the use of pressure sensitive tape and mastic.
- c. Flexible fiberglass duct size shall be same as air device neck size unless otherwise noted.
- d. Flexible fiberglass duct length shall be a maximum of 10 feet and a minimum of 6 feet.

G. DUCT ACCESS DOORS, PANELS AND SECTIONS

- 1. Provide duct access doors, sized and located for maintenance work, upstream, in the following locations:
 - a. Each fire damper (for link service), smoke damper and automatic control damper.
 - b. As otherwise required by prevailing codes or applicable standards (ASHRAE, NFPA, etc.).
- 2. Openings shall be as large as feasible in small ducts, 12 inch by 12 inch minimum where possible. Access sections in insulated ducts shall be double-wall, insulated.
- 3. For all duct types, refer to SMACNA HVAC Duct Construction Standards for additional requirements.
- 4. Provide associated ceiling access panels.

H. FIRE DAMPERS

- 1. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2 hour rating, 160 degrees F fusible link, 100 percent free opening with no part of the blade stack or damper frame in the air stream. All fire dampers shall be dynamically rated.
- 2. Fire dampers in wet air exhaust shall be of stainless steel construction, all others may be galvanized steel.
- 3. The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 14 gage, required to provide installation equivalent to the damper manufacturer's UL test installation. Submit manufacturer's installation instructions conforming to UL rating test.

I. TURNING VANES

1. Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
2. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
3. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting
4. Vanes shall be single wall for ducts up to 48 inches wide. Ducts shall be double wall for larger dimensions. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows".

J. FLEXIBLE CONNECTORS

1. Indoor System, Flexible Connector Fabric: Provide glass fabric double coated with neoprene. Fabric shall be 26 oz/square yard minimum weight, 480 lbf/inch in the warp tensile strength, 360 lbf/inch in filling tensile strength and shall have a service temperature of minus 40 to plus 200 degrees F.
2. Outdoor system, Flexible Connector Fabric: Provide glass fabric double coated with weatherproof, synthetic rubber resistant to UV Rays and ozone. Fabric shall be 24 oz/square yard minimum weight, 530 lbf/inch in the warp tensile strength, 440 lbf/inch in filling tensile strength and shall have a service temperature of minus 50 to plus 220 degrees F.
3. Vanes shall Flexible Connector Fabric: Provide glass fabric double coated with weatherproof, synthetic rubber resistant to UV Rays and ozone. Fabric shall be 24 oz/square yard minimum weight, 530 lbf/inch in the warp tensile strength, 440 lbf/inch in filling tensile strength and shall have a service temperature of minus 50 to plus 220 degrees F.
4. Materials to be flame-retardant and noncombustic fabrics.
5. Coatings to comply with UL 181, Class 1.
6. Metal Edge connectors to be factory fabricated with 3-1/2-inch-wide fabric strip attached to 2 strips of 2-3/4-inch wide, 0.028 inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.
7. Thrust limits: Provide combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - a. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - b. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

f. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

g. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

PART 3 – EXECUTION

A. INSTALLATION

1. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards.
2. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the project. Coordinate with other trades for space available and relative location of HVAC equipment and accessories in ceiling plenum and in ceiling grid. Duct sizes on the drawings are clear, inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
3. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards. Repair galvanized areas with galvanizing repair compound if duct is damaged during construction.
4. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.
5. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.
6. Install duct hangers and supports in accordance with SMACNA Standards.
7. Install fire dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test. Install fire dampers, smoke dampers and combination fire/smoke dampers at locations indicated and where ducts penetrate fire rated and/or smoke rated walls, shafts and where required by the prevailing codes or standards. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per UL and NFPA. Demonstrate re-setting of fire dampers and operation of smoke dampers.
8. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material per NFPA 90A.
9. Flexible duct installation: Refer to SMACNA Standards. Ducts shall be continuous, single pieces (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as

recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hour. Support ducts SMACNA Standards.

10. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.
11. Control Damper Installation: Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
12. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, where necessary. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

B. DUCT LEAKAGE TESTS AND REPAIR

1. Ductwork leakage testing shall be performed by the Testing and Balancing Contractor directly contracted by the General Contractor.
2. Ductwork leakage testing shall be performed for the entire air distribution system (including all supply, return, exhaust and relief ductwork), section by section, including fans, coils and filter sections. Based upon satisfactory initial duct leakage test results, the scope of the testing may be reduced by the Project Engineer on ductwork constructed up to the 2" WG duct pressure classification. In no case shall the leakage testing of ductwork constructed above the 2" WG duct pressure classification or ductwork located in shafts or other inaccessible areas be eliminated.
3. Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.
4. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
5. All tests shall be performed in the presence of the Mechanical Contractor, the General Contractor and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the Project Engineer and identify leakage source with excessive leakage.
6. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the Project Engineer.

7. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
8. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

End of Section

SECTION 23 34 00 - HVAC FANS

PART 1 – GENERAL

1. DEFINITIONS:
 - A. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
 - B. Option or optional: Contractor's choice of an alternate material or method.
2. DESCRIPTION
 - A. Fans for heating, ventilating and air conditioning.
 - B. Product Definitions: All relevant AMCA and ASHRAE publications.
3. QUALITY ASSURANCE
 - A. Fans and power ventilators shall be listed in the current edition of AMCA 26l, and shall bear the AMCA performance seal.
 - B. Fans and power ventilators shall comply with the following standards all applicable AMCA Standards.
 - C. Performance Criteria: The fan schedule shall show the design air volume and static pressure. Select the fan motor HP by increasing the fan BHP by 10 percent to account for the drive losses and field conditions. Submit fan performance curves with submittals.
 - D. All fan housings mounted external to the building shall be designed to meet the wind load rating criteria of the codes in effect at the time of permit. Fan housings must remain intact and securely fastened to curd during design wind velocities.

SUBMITTALS

- A. Manufacturers Literature and Data: Fan sections, motors, drives, accessories and coatings. Include information on supplied roof curb and fan mounting details. Fan submittals shall include specific information on the mounting of the roof curbs to the roof deck and mounting of the fan to the curb. Details shall be included to indicate how this mounting arrangement meets the design wind velocities necessitated by code. Provide certified sound power levels for each fan, motor ratings types, electrical characteristics and accessories.
- B. Certified fan performance curves for each fan showing cubic feet per minute (CFM) versus static pressure, efficiency, and horsepower for design point of operation.

PART 2 - PRODUCTS

1. CEILING MOUNTED FANS

- A. Type: Energy Star rated, ceiling mounted exhaust fans shall be of the centrifugal direct drive type. See mechanical schedule.
- B. Construction: The fan housing shall be constructed of galvanized steel. The polypropylene duct collar shall be 6 inches in diameter and shall include a backdraft damper. The designer grille shall be constructed of non-yellowing high-impact polystyrene and attached to the housing with hidden attachment screws. The access for wiring shall be external. The motor disconnect shall be internal and of the plug-in type. The motor shall be mounted on vibration isolators. The fan wheel shall be of the forward-curved centrifugal type, constructed of calcium carbonate filled polypropylene and dynamically balanced. All fans shall bear the AMCA Certified Ratings program AMCA Sound and Air Performance seal and shall be UL/cUL Listed.

PART 3 – EXECUTION

1. INSTALLATION

- A. Install fan, motor and drive in accordance with manufacturer's instructions.
- B. Align fan and motor sheaves to allow belts to run true and straight.
- C. Bolt equipment to curbs with galvanized lag bolts.
- D. Lubricate bearings, pulleys, belts and other moving parts with manufacturer recommended lubricants.
- E. Clean fan interiors to remove foreign material and construction dirt and dust.
- F. Verify operation of motor, drive system and fan wheel according to the drawings and specifications.
- G. Check vibration and correct as necessary for air balance work.
- H. After air balancing is complete and permanent sheaves are in place perform necessary field mechanical balancing to meet vibration tolerance.

End of Section

SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 – GENERAL

1. DESCRIPTION:

- A. Air Outlets and Inlets: Diffusers, Registers, and Grilles

2. QUALITY ASSURANCE:

- A. Comply with NFPA 90A, SMACNA, ASHRAE and the codes in effect at the time of permitting.
- B. Test and rate performance of air outlet and inlets in accordance with ASHRAE 70.
- C. Install louvers rated in accordance with AMCA 500.
- D. Comply with NFPA 90A.

3. SUBMITTALS:

- A. Shop Drawings:

- 1. Submit product data under provisions of the General Conditions. Submittal shall include a device schedule with type, size, finish, mounting type, and noise level.

4. STORAGE AND HANDLING OF MATERIAL:

- A. Store materials in clean and dry environment, device faces and exposed surfaces as installed shall be clean and undamaged.

PART 2 - PRODUCTS

1. DIFFUSERS, REGISTERS AND GRILLES:

- A. Acceptable Manufacturers include:

- 1. Titus
 - 2. Metalaire
 - 3. Price
 - 4. Hart and Cooley
 - 5. US Aire

- B. Material - Furnish as scheduled on the drawings. If no designation, furnish as aluminum with factory white finish, concealed fasteners, and with plaster trim ring for hard ceiling installations.
- C. Furnish with a volume damper, adjustable from the face, for all diffusers and registers.

2. SUPPLY CEILING REGISTERS

A. Acceptable Manufacturers include:

- a. Titus
- b. Metalaire
- c. Price
- d. Hart and Cooley
- e. US Aire

B. Three-way, stamped, curved blade, steel, see schedule.

3. SUPPLY FLOOR REGISTERS

A. Acceptable Manufacturers include:

- a. Titus
- b. Metalaire
- c. Price
- d. Hart and Cooley
- e. US Aire

B. Heavy gauge, steel, multi-angle fin setting, individually welded diffusion vanes, see schedule.

4. RETURN REGISTERS (LOUVERED):

A. Acceptable Manufacturers include:

- a. Titus
- b. Metalaire
- c. Price
- d. Hart and Cooley
- e. US Aire

B. Single-deflection with horizontal face bars and opposed blade damper. Furnish with 1/2" bar spacing set at 40 degrees. Steel construction, see schedule.

PART 3 – EXECUTION

1. GENERAL REQUIREMENTS:

- A. Protect devices and material from physical damage. Place devices in first class operating condition or return them to the supplier for replacement at no cost to the owner. Continue to protect installed devices until the system is turned over to the owner. Clean all devices and maintain them free from dirt and contamination.
- B. Install all devices according to the manufacture's installation directions.
- C. Paint visible interior portions of duct and plenums flat black.

- D. Secure all air devices to the duct with air-tight connections. Maintain insulation and vapor barrier integrity from backpan insulation to duct. The tops or rear of all supply and return air devices shall be insulated and sealed with a tape & mastic system.
- E. Coordinate device locations to comply with the most recent reflected ceiling plan and field adjust to maintain symmetric arrangements with all other ceiling devices and lighting.
- F. All air devices shall be provided with a means to balance the device. For devices mounted in hard ceilings or in locations where a branch duct volume damper would not be accessible, an opposed blade damper accessible from the face of the air device shall be provided.
- G. All air devices mounted in rated construction shall be provided with a corresponding damper type (fire, smoke or combo fire/smoke) consistent with the rating of the mounting location. Devices mounted in rated ceilings shall be provided with a radiation damper provided by the device manufacturer.

End of Section

SECTION 23 81 40 - AIR-COOLED UNITARY EQUIPMENT

PART 1 – GENERAL

1. DESCRIPTION

- A. This section includes design, performance, refrigerants, controls, and installation requirements for air-cooled packaged HVAC units.

2. DEFINITIONS:

- A. Coefficient of Performance (COP) - Cooling: The ratio of the rate of heat removed to the rate of energy input in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.
- B. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions.
- C. Heating Seasonal Performance Factor (HSPF) - Total heating output of heat pump during its normal annual usage period for heating in Btu/h divided by total electric energy input in watts during the same period.
- D. Seasonal Energy Efficiency Ratio (SEER) - Total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period.
- E. Air-Source Unitary Heat Pump: One or more factory made assemblies that normally include an indoor conditioning coil, compressor(s) and an outdoor refrigerant-to-air coil. These units provide both heating and cooling functions.

3. QUALITY ASSURANCE:

- A. Comply with ASHRAE Standard 90.1-2007, Energy Standard for Buildings except Low-Rise Residential Buildings for cooling and heating performance requirements when tested in accordance with AHRI Standards.
- B. Heating Performance shall conform to ASHRAE requirements when tested in accordance with AHRI Standards.
- C. Comply with specification requirements for seismic restraints if applicable.
- D. Scheduled performance represents the minimum acceptable level of performance.

- E. Manufacturer shall provide for design of all refrigerant piping systems to include line sizing and refrigerant pressure requirements. Manufacturer shall provide all components necessary for reliable operation in long line length applications. It shall be the responsibility of the manufacturer to identify if the maximum distance, both vertical and total distance exceeds the listed limits of the equipment and to provide equipment and components necessary for reliable operation given the length of the refrigerant line runs.

4. SUBMITTALS

- A. Submit in accordance with specifications.
- B. Manufacturer's Literature and Data:
 - 1. Air-Source Unitary Equipment:
 - a. Packaged units
 - b. Split system
- C. Certification: Submit, simultaneously with shop drawings, a proof of certification that this product has been certified by AHRI.
- D. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required cooling and heating capacities EER and COP values as applicable.
- E. Performance information indicated in the equipment schedules shall represent the minimum level of acceptable performance. All submitted equipment shall meet or exceed the stated performance.
- F. Submit wind load pressure calculations for exterior components to demonstrate compliance with the prevailing codes at the time of permit. This shall include unit casing calculations, unit to curb attachment calculations and curb to roof calculations.

PART 2- PRODUCTS

1. UNITARY EQUIPMENT (PACKAGED AND SPLIT SYSTEMS)

- A. Units shall have factory assembled refrigerant circuits and shall be provided with filter/dryers, shut-off valves, gage ports, charge port, thermostatic expansion valves, integral disconnect switch, thermostat or controls interface as applicable, overcurrent protection for individual components, phase loss protection with automatic restart, refrigerant pressure safeties with automatic reset and factory start-up service.
- B. Casing: Indoor unit shall be constructed of zinc coated, heavy-gage galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Standard factory unit coatings shall be tested 500 hours in a salt spray test in compliance with ASTM B117. Cabinet panels shall have lifting handles and shall be water- and air-tight seal. All exposed vertical, top covers and base pan shall be insulated with 1-inch matt-faced, fire-resistant, odorless, glass fiber material. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1. The base of

the unit shall have provisions for forklift and crane lifting if required. Unit casings shall be designed to withstand the wind load ratings required by the prevailing codes at time of permit. All packaged units and condensing units shall be securely attached to the mounting pad, frame or structure and such attachments shall be designed to resist the wind loading requirements of the prevailing code at the time of permit.

- C. Filters: One inch, MERV 13, throwaway filters shall be factory supplied on all units. For LEED certified projects, provide filters in accordance with the proposed credits. 3 sets of filters shall be provided during the construction process. New filters shall be installed prior to the test and balance process and new filters shall be installed at final completion. 1 complete set of filters shall be left with the owner after final completion. It shall be the contractor's responsibility to maintain construction filters on all units and duct systems if units are to be operated during the construction process.
- D. Compressors: Compressors shall be direct-drive, hermetic scroll type with centrifugal type oil pumps. Motor shall be suction gas-cooled. Internal overloads and crankcase heaters shall be utilized with all compressors. Heat pumps shall be provided with extended range operation and automatic reversing valve.
- E. Refrigerant Circuit: A minimum of two circuits is required for each unit if available from the manufacturer. Otherwise, units shall have the capability to reduce capacity either through varying the speed of the compressor or staging the compressor. Capacity control valves (Rawal) shall be an acceptable alternative only if variable capacity is not available. Each refrigerant circuit shall have independent thermostatic expansion devices, service pressure ports, and refrigerant line filter driers factory installed as standard. An area shall be provided for replacement suction line driers.
- F. Evaporator and Condenser Coils: Internally finned, copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. The evaporated coil and condenser coil shall be leak tested at the factory to 3 times design operating pressure. All dual compressor units shall have intermingled evaporator coils. IAQ rated stainless steel condensate drain pans shall be provided. For units with outdoor air flow rates exceeding 15% of the total supply air volume and located within 15 miles of the sea coast, a sea coast rated coating shall be applied to the evaporator coil.
- G. All split system air handling units shall be provided with galvanized secondary drain pans with water sensing float switch. Float switch shall be hard wired to interrupt operation of the unit in the event water is sensed in the secondary drain pan.
- H. Outdoor fans: Direct driven, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motors shall be permanently lubricated and shall have built-in thermal overload protection.
- I. All condensing units or packaged units shall be provided with louvered hail guards for protection of the condenser coils.
- J. For roof mounted units, provide a factory pre-fabricated roof curb and mounting details to indicate that unit mounting to curb and curb mounting to roof is capable of withstanding the design wind loading.
- K. Unit casing shall be capable of withstanding the design wind loading without separation from curb and must remain intact in accordance with prevailing codes.

- L. Indoor Fan: Forward-Curved, Centrifugal Fan. Provide direct drive if available or provide V-belt driven with adjustable motor sheaves. Motors shall be thermally protected. Provide oversized motors for high static application. Motors shall meet the U.S. Energy Policy Act of 2005 (EPACT). Provide variable speed ECM motors if available from unit manufacturer.
- M. For all split system and packaged DX systems with outdoor air quantities exceeding 15% of the total supply air quantity for that unit, a modulating hot gas reheat coil shall be provided to ensure humidity control under all unit operating conditions. As an alternative, the unit manufacturer may provide another means to control humidity as long as the proposed means is equal in performance and ability to dehumidify as the hot gas reheat coil system. Dehumidification means must be compliant with the prevailing energy code in effect at the time of permitting.
- N. All units shall be provided with a unitary controller capable of controlling all unit functions to include; start/stop, temperature control, humidity control, etc.
- O. Provide completely assembled, wired, and piped gas fired heating system within unit. Design to be certified by UL, specifically for outdoor application (packaged units) or indoor application (furnace). Provide threaded gas connection on the unit
- P. Provide and electronic ignition system where the main burner is lit each time the thermostat calls for heat. Flam sensor shall prove flame and keep main burner(s) on. Should a loss of flame occur, the main valve closes and the spark recurs. When the thermostat is satisfied, the main burner is extinguished.
- Q. Defrost Controls (heat pump units): A time initiated, temperature terminated defrost system shall ship with a setting of 70-minute cycle, with a choice of 50- or 90-minute cycle. Timed override limits defrost cycle to 10 minutes shall be available on units from 10 to 20 tons. Adaptive demand defrost shall be provided on units below 10 Tons.
- R. Unit Electrical:
 - 1. Provide single point unit power connection and unit mounted disconnect switch.
 - 2. Unit control box shall be located within the unit and shall contain controls for compressor, reversing valve and fan motor operation and shall have a 50 VA 24-volt control circuit transformer and a terminal block for low voltage field wiring connections.
 - 3. Safety Controls - High pressure, low temperature, and low pressure safety switches shall be wired through a latching lockout circuit to hold the conditioner off until it is reset electrically by interrupting the power supply to the conditioner. All safety switches shall be normally closed, opening upon fault detection.
 - 4. Provide all packaged units with a step down transformer and a 120 volt, 20 amp convenience outlet mounted in a weatherproof enclosure. Convenience outlet shall be wired so that when main power disconnect is in the off position, outlet is still energized.

2. OPERATING CONTROLS

- A. Low voltage, adjustable room thermostat to control heating and cooling in sequence with delay between stages, compressor and supply fan to maintain temperature setting. Include system selector switch (off-heat-auto-cool) and fan control switch (auto-on). Thermostats are to be provided with adaptive recovery for all heat pump based systems. Thermostats shall be Honeywell VisionPRO IAQ series with integral 7 day programming and humidistat. System shall be capable of operating in dehumidification mode regardless of space temperature when humidity levels exceed setpoints.

PART 3- EXECUTION

1. INSTALLATION

- A. Install split systems according to manufacturers printed instructions.
- B. Manufacturer shall provide for design of all refrigerant piping systems to include line sizing and refrigerant pressure requirements. Manufacturer shall provide all components necessary for reliable operation in long line length applications. It shall be the responsibility of the manufacturer to identify if the maximum distance, both vertical and total distance exceeds the listed limits of the equipment and to provide equipment and components and equipment necessary for reliable operation given the length of the refrigerant line runs.
- C. Install electrical and control devices furnished by the manufacturer but not specified to be factory mounted. All electrical work shall comply with the electrical specifications
- D. Perform startup checks according to manufacturer's written instructions.
- E. Provide factory start-up for all units. Provide Project Engineer and Commissioning Agent with copies of the factory start-up sheets.
- F. Test controls and demonstrate its compliance with project requirements. Replace damaged or malfunctioning controls and equipment and retest the equipment to the satisfaction of the Project Engineer.
- G. Provide services of manufacturer's technical representative for four hours to instruct owner personnel in operation and maintenance of units.

End of Section

SECTION 23 82 46 – ELECTRIC UNIT HEATERS

PART 1 – GENERAL

1. REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. UNDERWRITERS LABORATORIES (UL) UL 1996 (2009; Reprint Nov 2011) Electric Duct Heaters

2. SUBMITTALS

- A. Section 26 0511 REQUIREMENTS FOR ELECTRICAL INSTALLATIONS applies to work specified in this section.
- B. Include unit heaters in submitted Fabrication Drawings.
- C. Submit Equipment and Performance Data for electric heaters life, test, system functional flows, safety features, and mechanical automated details.
- D. Submit Manufacturer's Instructions for electric heaters stating the special provisions required to install equipment components and system packages. Detail impedances, hazards and safety precautions within the special notices.
- E. Submit warranty data.

PART 2 - PRODUCTS

1. PRODUCT STANDARDS

- A. Provide products conforming to the requirements of UL 1996 for electric unit heaters.

2. DESCRIPTION

- A. Provide suspended electric unit heaters and arrange for discharge of air as indicated.

Provide electric unit heaters with not less than the indicated capacity and conform to requirements specified herein. Ensure electric unit heaters are factory prewired, ready for field terminal connections.

3. CASINGS

- A. Construct casings with smoothly contoured propeller orifice rings of not less than 20-gage cold-rolled carbon steel. Provide casing surface finish with phosphate pretreatment, prime coating, and baked-enamel finish.

4. AIR DISTRIBUTION

- A. Fit vertical discharge units with louver-cone diffusers. Provide horizontal units with adjustable single- or double-deflection louvers.

5. HEATING ELEMENT

- A. Construct heating element of a resistance wire insulated by highly compacted refractory insulation protected by a sealed metallic-finned sheath. Component materials are as follows:
- B. Provide resistance wire not less than 20-helix wound alloy approximately 80-percent nickel and 20-percent chromium.
- C. Provide refractory insulation of magnesium oxide with a resistance of not less than 50,000-ohms after exposure to an ambient temperature and humidity of 90 degrees F and 85 plus or minus 5-percent relative humidity, respectively, for not less than 24 hours.
- D. Provide sheathing consisting of aluminum fins cast around an internal steel sheath containing refractory insulation and resistance wire or carbon-steel fins permanently attached to a tubular carbon-steel sheath containing refractory insulation and resistance wire and with external surfaces porcelainized.

6. CONTROLS

- A. Fit units up to and including 5 kilowatts with integral controls including thermal overload cutout switches, necessary transformers, liquid-vapor system, and low-mass bimetal thermostat. Provide automatically resettable cutout switch.
- B. If indicated on the electrical drawings, provide unit with a remote unfused disconnect switch that opens ungrounded conductors in the OFF position and a thermostat with integral controls including thermal overload cutout switches, magnetic contactors, necessary transformers, and thermostat protection. Provide automatically resettable cutout switches.

- C. If indicated on the mechanical drawings, provide wall-mounted thermostats complete with thermometer, mechanical high-limit stop, calibrated operator, and an adjustable heater to effect anticipation and to prevent override of space temperature with a range between 55 and 105 degrees F and a differential not exceeding 1.5 degrees F. Provide thermostat rated for operation at 24 volts, 60 hertz. Provide transformers, wiring, and devices necessary to meet this requirement. Finish cases in brushed or satin chrome.

7. PROPELLERS AND MOTORS

- A. Provide propellers with mill-aluminized blades statically and dynamically balanced to within 0.5 percent. Provide units with fan-inlet safety guards. AMCA certify propellers and motors for air performance and noise level.
- B. Protect motors against damage by the heating element and resilient mount. Motor bearings may be manufacturer's standard prelubricated sleeve type.
- C. Provide motor identification plate per manufacturer's standard.
- D. Provide motor speed and control per unit-heater manufacturer's standard.

PART 3 - EXECUTION

1. INSTALLATION

- A. Install unit heaters in accordance with the manufacturer's instructions at the mounting heights indicated.

2. FIELD TESTING

- A. Demonstrate that the unit heaters operate satisfactorily. Cycle unit heaters five times, from start to operating thermal conditions to off, to verify adequacy of construction, system controls, and component performance. Conduct an operational test for a minimum of 6 hours.

End of Section

SECTION 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 – GENERAL

1. DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, switchgear, panelboards, motor control centers, and other items and arrangements for the specified items are shown on the drawings.
- C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.

2. MINIMUM REQUIREMENTS

- A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

3. TEST STANDARDS

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
 - 1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.

2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
 3. Certified: Materials and equipment which:
 - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Are periodically inspected by a NRTL.
 - c. Bear a label, tag, or other record of certification.
 4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.
4. QUALIFICATIONS (PRODUCTS AND SERVICES)
- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
 - B. Product Qualification:
 1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
 2. The Owner reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.
 - C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within // four // eight // hours of receipt of notification that service is needed. Submit name and address of service organizations.
5. APPLICABLE PUBLICATIONS
- A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.
 - B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.
6. MANUFACTURED PRODUCTS
- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.

- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
 - 1. The Owner shall have the option of witnessing factory tests. The Contractor shall notify the Owner a minimum of 15 working days prior to the manufacturer's performing the factory tests.
 - 2. Four copies of certified test reports shall be furnished to the Owner two weeks prior to final inspection and not more than 90 days after completion of the tests.
 - 3. When materials and equipment fail factory tests, and re-testing and re-inspection is required, the Contractor shall be liable for all additional expenses for the Owner to witness re-testing.

7. VARIATIONS FROM CONTRACT REQUIREMENTS

- A. Where the Owner or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

8. MATERIALS AND EQUIPMENT PROTECTION

- A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
 - 1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
 - 2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.

3. Damaged equipment shall be repaired or replaced, as determined by the Owner.
4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl..
5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

9. WORK PERFORMANCE

- A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J – General Environmental Controls, OSHA Part 1910 subpart K – Medical and First Aid, and OSHA Part 1910 subpart S – Electrical, in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
 1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
 2. Before initiating any work, a job specific work plan must be developed by the Contractor with a peer review conducted and documented by Owner. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
 3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Owner.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions.
- F. Coordinate location of equipment and conduit with other trades to minimize interference.

10. EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.
- C. Inaccessible Equipment:

1. Where the Owner determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Owner.
 2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
- D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.

11. EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
- B. Identification signs for equipment shall be laminated black phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation. Secure nameplates with screws.
- C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm²), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

12. SUBMITTALS

- A. Submit to the Owner.
- B. The Owner's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Owner to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION (applicable section)".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports.
2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion, etc.) associated with equipment or piping so that the proposed installation can be properly reviewed. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and attached to the equipment.//
3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 - a. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.

F. Maintenance and Operation Manuals:

1. Submit for systems and equipment specified in the technical sections. Furnish in hardcover binders.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.

- c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
 - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
- G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
- H. After approval and prior to installation, furnish the Owner with one sample of each of the following:
- 1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
 - 2. Each type of conduit coupling, bushing, and termination fitting.
 - 3. Conduit hangers, clamps, and supports.
 - 4. Duct sealing compound.
 - 5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

13. SINGULAR NUMBER

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

14. ACCEPTANCE CHECKS AND TESTS

- A. The Contractor shall furnish the instruments, materials, and labor for tests.
- B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Owner.
- C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Owner.

15. WARRANTY

- A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Owner.

16. INSTRUCTION

- A. Instruction to designated Owner personnel shall be provided for the particular equipment or system in each associated technical specification section.
- B. Furnish the services of competent instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be trained in operating theory as well as practical operation and maintenance procedures.
- C. A training schedule shall be developed and submitted by the Contractor and approved by the Owner at least 30 days prior to the planned training.

END OF SECTION 26 05 11

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1. DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

2. QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

3. FACTORY TESTS

- A. Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

4. SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:

- a. Submit sufficient information to demonstrate compliance with drawings and specifications.
- b. Submit the following data for approval:
 - 1) Electrical ratings and insulation type for each conductor and cable.
 - 2) Splicing materials and pulling lubricant.

2. Certifications: Two weeks prior to final inspection, submit the following.

- a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

5. APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.
- B. American Society of Testing Material (ASTM):

- D2301-10 Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
- D2304-10 Test Method for Thermal Endurance of Rigid Electrical Insulating Materials
- D3005-10 Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):
- WC 70-09 Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
- D. National Fire Protection Association (NFPA):
- 70-11 National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
- 44-10 Thermoset-Insulated Wires and Cables
- 83-08 Thermoplastic-Insulated Wires and Cables
- 467-07 Grounding and Bonding Equipment
- 486A-486B-03 Wire Connectors
- 486C-04 Splicing Wire Connectors
- 486D-05 Sealed Wire Connector Systems
- 486E-09 Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
- 493-07 Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables
- 514B-04 Conduit, Tubing, and Cable Fittings

PART 2 - PRODUCTS

1. CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.
- B. Single Conductor and Cable:
1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
 2. No. 8 AWG and larger: Stranded.

3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

C. Direct Burial Cable: UF or USE cable.

D. Color Code:

1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
2. No. 8 AWG and larger: Color-coded using one of the following methods:
 - a. Solid color insulation or solid color coating.
 - b. Stripes, bands, or hash marks of color specified.
 - c. Color using 19 mm (0.75 inches) wide tape.
3. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
4. Conductors shall be color-coded as follows:

208/120 V	Phase	
Black	A	
Red	B	
Blue	C	
White	Neutral	

5. Lighting circuit "switch legs", and 3-way and 4-way switch "traveling wires," shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC.

2. SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
 1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.

2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:

1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.
4. All bolts, nuts, and washers used with splices shall be zinc-plated, cadmium-plated steel.

D. Above Ground Splices for 250 kcmil and Larger:

1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

E. Underground Splices for No. 10 AWG and Smaller:

1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

F. Underground Splices for No. 8 AWG and Larger:

1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper and aluminum conductors.

- 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 - 3. Splice and insulation shall be product of the same manufacturer.
- G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.
- 3. CONNECTORS AND TERMINATIONS
 - A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
 - B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
 - C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated, cadmium-plated steel.
- 4. CONTROL WIRING
 - A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
 - B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.
- 5. 2.5 WIRE LUBRICATING COMPOUND
 - A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.
 - B. Shall not be used on conductors for isolated power systems.

PART 3 - EXECUTION

- 1. GENERAL
 - A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.
 - B. Install all conductors in raceway systems.
 - C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.
 - D. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
 - E. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.

- F. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- G. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
- H. Conductor and Cable Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
 - 2. Use nonmetallic pull ropes.
 - 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
 - 4. All conductors in a single conduit shall be pulled simultaneously.
 - 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- I. No more than three branch circuits shall be installed in any one conduit.
- J. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

2. INSTALLATION IN MANHOLES

- A. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.
- B. Fireproofing:
 - 1. Install fireproofing on low-voltage conductors where the low-voltage conductors are installed in the same manholes with medium-voltage conductors.
 - 2. Use fireproofing tape and apply the tape in a single layer, half-lapped, or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (1 inch) into each duct.
 - 3. Secure the fireproofing tape in place by a random wrap of glass cloth tape.

3. SPLICE AND TERMINATION INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Owner determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Owner.

4. CONDUCTOR IDENTIFICATION

- A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

5. FEEDER CONDUCTOR IDENTIFICATION

- A. In each interior pullbox and each underground manhole and handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

6. CONTROL WIRING INSTALLATION

- A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.
- B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

7. CONTROL WIRING IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

8. DIRECT BURIAL CABLE INSTALLATION

- A. Tops of the cables:
 - 1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
 - 2. Below road and other pavement surfaces: In conduit as specified, minimum 760 mm (30 inches) unless greater depth is shown.
 - 3. Do not install cables under railroad tracks.
- B. Under road and paved surfaces: Install cables in concrete-encased galvanized steel rigid conduits. Size as shown on plans, but not less than 50 mm (2 inches) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare.

- C. Work with extreme care near existing ducts, conduits, cables, and other utilities to prevent any damage.
- D. Excavation and backfill.
 - 1. Place 75 mm (3 inches) bedding sand in the trenches before installing the cables.
 - 2. Place 75 mm (3 inches) shading sand over the installed cables.
 - 3. Install continuous horizontal 25 mm by 200 mm (1 inch x 8 inches) preservative-impregnated wood planking 75 mm (3 inches) above the cables before backfilling.
- E. Provide horizontal slack in the cables for contraction during cold weather.
- F. Install the cables in continuous lengths. Splices within cable runs shall not be accepted.
- G. Connections and terminations shall be listed submersible-type designed for the cables being installed.
- H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried cables.

9. ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests: Inspect physical condition.
 - 2. Electrical tests:
 - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester.
 - b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
 - c. Perform phase rotation test on all three-phase circuits.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1. DESCRIPTION
 - A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
 - B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
 - C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.
2. QUALITY ASSURANCE
 - A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
3. SUBMITTALS
 - A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
 2. Test Reports:
 - a. Two weeks prior to the final inspection, submit ground resistance field test reports to the Owner.
 3. Certifications:
 - a. Certification by the Contractor that the grounding equipment has been properly installed and tested.
4. APPLICABLE PUBLICATIONS
 - A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
 - B. American Society for Testing and Materials (ASTM):

B1-07.....Standard Specification for Hard-Drawn Copper Wire

B3-07.....Standard Specification for Soft or Annealed Copper Wire

B8-11.....Standard Specification for Concentric-Lay-Stranded Copper
Conductors, Hard, Medium-Hard, or Soft

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-83IEEE Guide for Measuring Earth Resistivity, Ground Impedance,
and Earth Surface Potentials of a Ground System Part 1:
Normal Measurements

D. National Fire Protection Association (NFPA):

70-11National Electrical Code (NEC)

70E-12.....National Electrical Safety Code

99-12Health Care Facilities

E. Underwriters Laboratories, Inc. (UL):

44-10Thermoset-Insulated Wires and Cables

83-08Thermoplastic-Insulated Wires and Cables

467-07Grounding and Bonding Equipment

PART 2 - PRODUCTS

1. GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.

B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.

C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

2. GROUND RODS

A. Steel or copper clad steel, Stainless steel, 19 mm (0.75 inch) diameter by 3 M (10 feet) long.

B. Quantity of rods shall be as shown on the drawings to obtain the specified ground resistance.

3. CONCRETE ENCASED ELECTRODE

A. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

4. GROUND CONNECTIONS

- A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.
- B. Above Grade:
 - 1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated, cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
 - 2. Connection to Building Steel: Exothermic-welded type connectors.
 - 3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated, cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
 - 4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated, cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

5. EQUIPMENT RACK AND CABINET GROUND BARS

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 inch) thick x 19 mm (0.75 inch) wide, with lengths as shown on the drawings. Provide insulators and mounting brackets.

6. GROUND TERMINAL BLOCKS

- A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated, cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

7. GROUNDING BUS BAR

- A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

PART 3 - EXECUTION

1. GENERAL

- A. Install grounding equipment in accordance with the NEC, as shown on the drawings, and as specified herein.
- B. System Grounding:

1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.
2. INACCESSIBLE GROUNDING CONNECTIONS
 - A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.
3. MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS
 - A. Pad-Mounted Transformers:
 1. Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad.
 2. Ground the secondary neutral.
 - B. Lightning Arresters: Connect lightning arresters to the equipment ground bus or ground rods as applicable.
4. SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS
 - A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
 - B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):
 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
 2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.
 - C. Switchgear, Switchboards, Panelboards, and other electrical equipment:
 1. Connect the equipment grounding conductors to the ground bus.
 2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.
5. RACEWAY
 - A. Conduit Systems:

1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
 3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
 4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
- D. Wireway Systems:
1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
 2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
 3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
 4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).
- E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

- F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
 - G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
6. CORROSION INHIBITORS
- A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.
7. CONDUCTIVE PIPING
- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
8. MAIN ELECTRICAL ROOM GROUNDING
- A. Provide ground bus bar and mounting hardware at each main electrical room where incoming feeders are terminated, as shown on the drawings. Connect to pigtail extensions of the building grounding ring, as shown on the drawings.
9. EXTERIOR LIGHT POLES
- A. Provide 6.1 M (20 feet) of No. 4 AWG bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation to reach pole ground stud.
10. GROUND RESISTANCE
- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Owner. Final tests shall ensure that this requirement is met.
 - B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.
11. GROUND ROD INSTALLATION
- A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.
 - B. For indoor installations, leave 100 mm (4 inches) of each rod exposed.
 - C. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.

- D. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

12. ACCEPTANCE CHECKS AND TESTS

- A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.
- B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Below-grade connections shall be visually inspected by the Owner prior to backfilling. The Contractor shall notify the Owner 24 hours before the connections are ready for inspection.

END OF SECTION 26 05 26

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1. DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

2. QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

3. SUBMITTALS

In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

- A. Manufacturer's Literature and Data: Showing each cable type and rating. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Shop Drawings:
 - 1. Size and location of main feeders.
 - 2. Size and location of panels and pull-boxes.
 - 3. Layout of required conduit penetrations through structural elements.
- C. Certifications:
 - 1. Two weeks prior to the final inspection, submit four copies of the following certifications to the Owner:
 - a. Certification by the manufacturer that the material conforms to the requirements of the drawings and specifications.
 - b. Certification by the contractor that the material has been properly installed.

4. APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

- B. American National Standards Institute (ANSI):

C80.1-05.....Electrical Rigid Steel Conduit

- C80.3-05..... Steel Electrical Metal Tubing
- C80.6-05..... Electrical Intermediate Metal Conduit
- C. National Fire Protection Association (NFPA):
 - 70-08 National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
 - 1-05 Flexible Metal Conduit
 - 5-04 Surface Metal Raceway and Fittings
 - 6-07 Electrical Rigid Metal Conduit - Steel
 - 50-95 Enclosures for Electrical Equipment
 - 360-093 Liquid-Tight Flexible Steel Conduit
 - 467-07 Grounding and Bonding Equipment
 - 514A-04..... Metallic Outlet Boxes
 - 514B-04..... Conduit, Tubing, and Cable Fittings
 - 514C-96..... Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
 - 651-05 Schedule 40 and 80 Rigid PVC Conduit and Fittings
 - 651A-00..... Type EB and A Rigid PVC Conduit and HDPE Conduit
 - 797-07 Electrical Metallic Tubing
 - 1242-06 Electrical Intermediate Metal Conduit - Steel
- E. National Electrical Manufacturers Association (NEMA):
 - TC-2-03 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
 - TC-3-04 PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - FB1-07..... Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

PART 2 - PRODUCTS

- 1. MATERIAL
 - A. Conduit Size: In accordance with the NEC, but not less than 0.5 in [13 mm] unless otherwise shown. Where permitted by the NEC, 0.5 in [13 mm] flexible conduit may be used for tap connections to recessed lighting fixtures.
 - B. Conduit:

1. Electrical metallic tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 4 in [105 mm] and shall be permitted only with cable rated 600 V or less.
2. Flexible galvanized steel conduit: Shall conform to UL 1.
3. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
- C. Conduit Fittings:
 1. Electrical metallic tubing fittings:
 - a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Compression couplings and connectors: Concrete-tight and rain-tight, with connectors having insulated throats.
 - d. Setscrew couplings and connectors: Use setscrews of case-hardened steel with hex head and cup point, to firmly seat in wall of conduit for positive grounding.
 - e. Indent-type connectors or couplings are prohibited.
 - f. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
 2. Flexible steel conduit fittings:
 - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp-type, with insulated throat.
 3. Direct burial plastic conduit fittings:

Fittings shall meet the requirements of UL 514C and NEMA TC3.
 4. Expansion and deflection couplings:
 - a. Conform to UL 467 and UL 514B.
 - b. Accommodate a 0.75 in [19 mm] deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 - c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.

- D. Conduit Supports:
 - 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
 - 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 - 3. Multiple conduit (trapeze) hangers: Not less than 1.5 x 1.5 in [38 mm x 38 mm], 12-gauge steel, cold-formed, lipped channels; with not less than 0.375 in [9 mm] diameter steel hanger rods.
 - 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
 - 1. UL-50 and UL-514A.
 - 2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
 - 3. Non-metallic boxes:
 - 4. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.

PART 3 - EXECUTION

- 1. PENETRATIONS
 - A. Cutting or Holes:
 - 1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the Owner prior to drilling through structural elements.
 - 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except where permitted by the Owner because of limited working space.
 - B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases.
 - C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight.
- 2. INSTALLATION, GENERAL
 - A. In accordance with UL, NEC, as shown, and as specified herein.
 - B. Install conduit as follows:

1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
 2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
 3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
 4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 5. Cut square, ream, remove burrs, and draw up tight.
 6. Independently support conduit at 8 ft on centers. Do not use other supports, i.e., suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts.
 7. Support within 12 in of changes of direction, and within 12 in of each enclosure to which connected.
 8. Close ends of empty conduit with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
 9. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
 10. Flashing of penetrations of the roof membrane.
 11. Conduit bodies shall only be used for changes in direction, and shall not contain splices.
 12. Do not use aluminum conduits in wet locations.
- C. Conduit Bends:
1. Make bends with standard conduit bending machines.
 2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
 3. Bending of conduits with a pipe tee or vise is prohibited.
3. CONCEALED WORK INSTALLATION
- A. In Concrete:
1. Conduit: EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
 2. Align and run conduit in direct lines.

3. Installation of conduit in concrete that is less than 3 in [75 mm] thick is prohibited.
 - a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
 - b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.
 - c. Install conduits approximately in the center of the slab so that there will be a minimum of 0.75 in [19 mm] of concrete around the conduits.
4. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.
4. MOTORS AND VIBRATING EQUIPMENT
 - A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
5. EXPANSION JOINTS
 - A. Conduits 3 in [75 mm] and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
 - B. Provide conduits smaller than 3 in [75 mm] with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 5 in [125 mm] vertical drop midway between the ends. Flexible conduit shall have a bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for conduits 15 in [375 mm] and larger are acceptable.
 - C. Install expansion and deflection couplings where shown.
 - D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 15 in [375 mm] of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.
6. CONDUIT SUPPORTS, INSTALLATION
 - A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
 - B. Use pipe straps or individual conduit hangers for supporting individual conduits.
 - C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 200 lbs [90 kg]. Attach each conduit with U-bolts or other approved fasteners.
 - D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 0.25 in [6 mm] bolt size and not less than 1.125 in [28 mm] embedment.
 - b. Power set fasteners not less than 0.25 in [6 mm] diameter with depth of penetration not less than 3 in [75 mm].
 - c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.
- 7. BOX INSTALLATION
 - A. Boxes for Concealed Conduits:
 - 1. Flush-mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
 - B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations.
 - C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
 - D. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 24 in center-to-center lateral spacing shall be maintained between boxes.
 - E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 4 in square x 2.125 in deep, with device covers for the wall material and thickness involved.

- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."
- G. On all branch circuit junction box covers, identify the circuits with black marker.

END OF SECTION 26 05 33

SECTION 26 09 23 - LIGHTING CONTROLS

PART 1 - GENERAL

1. DESCRIPTION
 - A. This section specifies the furnishing, installation and connection of the lighting controls.
2. QUALITY ASSURANCE
 - A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
3. SUBMITTALS
 - A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
 - B. Product Data: For each type of lighting control, submit the following information.
 1. Manufacturer's catalog data.
 2. Wiring schematic and connection diagram.
 3. Installation details.
 - C. Manuals:
 1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
 2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the Resident Engineer.
 - D. Certifications:
 1. Two weeks prior to final inspection, submit four copies of the following certifications to the Resident Engineer:
 - a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.
4. APPLICABLE PUBLICATIONS
 - A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
 - B. Green Seal (GS):

GC-12.....Occupancy Sensors

- C. Illuminating Engineering Society of North America (IESNA):
 - IESNA LM-48 Guide for Calibration of Photoelectric Control Devices
- D. National Electrical Manufacturer's Association (NEMA)
 - C136.10 American National Standard for Roadway Lighting Equipment-
Locking-Type Photocontrol Devices and Mating
Receptacles - Physical and Electrical Interchangeability and
Testing
 - ICS-1 Standard for Industrial Control and Systems General Requirements
 - ICS-2 Standard for Industrial Control and Systems: Controllers,
Contractors, and Overload Relays Rated Not More than
2000 Volts AC or 750 Volts DC: Part 8 - Disconnect
Devices for Use in Industrial Control Equipment
 - ICS-6 Standard for Industrial Controls and Systems Enclosures
- E. Underwriters Laboratories, Inc. (UL):
 - 20 Standard for General-Use Snap Switches
 - 773 Standard for Plug-In Locking Type Photocontrols for Use with Area
Lighting
 - 773A Nonindustrial Photoelectric Switches for Lighting Control
 - 98 Enclosed and Dead-Front Switches
 - 917 Clock Operated Switches

PART 2 - PRODUCTS

- 1. ELECTRONIC TIME SWITCHES
 - A. Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 - 1. Contact Configuration: SPST, DPST, DPDT.
 - 2. Contact Rating: 30-A inductive or resistive, 240-V ac, 20-A ballast load, 120/240-V ac.
 - 3. Astronomical Clock: Capable of switching a load on at sunset and off at sunrise, and automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Additionally, it shall be programmable to a fixed on/off weekly schedule.
 - 4. Battery Backup: For schedules and time clock.
- 2. ELECTROMECHANICAL-DIAL TIME SWITCHES
 - A. Electromechanical-dial time switches; complying with UL 917.

1. Contact Configuration: SPST, DPST, DPDT.
2. Contact Rating: 30-A inductive or resistive, 240-V ac, 20-A ballast load, 120/240-V ac.
3. Wound-spring reserve carryover mechanism to keep time during power failures.

3. OUTDOOR PHOTOELECTRIC SWITCHES

- A. Solid state, with SPST, DPST, dry contacts rated for 1800 VA tungsten or 1000 VA inductive, complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc [16.14 to 108 lx], with adjustable turn-on and turn-off levels.
 2. Time Delay: 15-second minimum.
 3. Surge Protection: Metal-oxide varistor.
 4. Mounting: Twist lock, with base-and-stem mounting or stem-and-swivel mounting accessories as required.

4. CEILING-MOUNTED PHOTOELECTRIC SWITCHES

- A. Solid-state, light-level sensor unit, with separate relay unit.
1. Sensor Output: Contacts rated to operate the associated relay. Sensor shall be powered from the relay unit.
 2. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
 3. Monitoring Range: 10 to 200 fc [108 to 2152 lx], 100 to 1000 fc [1080 to 10 800 lx], with an adjustment for turn-on and turn-off levels.
 4. Time Delay: Adjustable from 5 to 300 seconds, with deadband adjustment.
 5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

5. INDOOR OCCUPANCY SENSORS

- A. Wall- or ceiling-mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1 to 15 minute adjustable time delay for turning lights off.
 2. Sensor Output: Contacts rated to operate the connected relay. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.

4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Manual/automatic selector switch.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc [21.5 to 2152 lx]; keep lighting off when selected lighting level is present.
 9. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.
- B. Dual-technology Type: Ceiling mounting; combination PIR and ultrasonic detection methods, field-selectable.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch [150mm] minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. [232 sq. cm], and detect a person of average size and weight moving not less than 12 inches [305 mm] in either a horizontal or a vertical manner at an approximate speed of 12 inches/s [305 mm/s].
 3. Detection Coverage: as scheduled on drawings.

PART 3 - EXECUTION

1. INSTALLATION:
 - A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.
 - B. Aim outdoor photocell switch according to manufacturer's recommendations. Set adjustable window slide for 1 footcandle photocell turn-on.
 - C. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer's recommendations.
 - D. Set occupancy sensor "on" duration to 5, 10, 15 minutes.
 - E. Locate light level sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the scheduled light level at the typical work plane for that area.
 - F. Label time switches and contactors with a unique designation.

2. ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations.
- B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.
- C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.
- D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.
- E. Program lighting control panels per schedule on drawings.
- F. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory-authorized technician who will verify all adjustments and sensor placements.

3. FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function.

END OF SECTION 26 09 23

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1. DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of panelboards.

2. QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

3. SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:

- a. Submit sufficient information to demonstrate compliance with drawings and specifications.
- b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.
- c. Certification from the manufacturer that a representative panelboard has been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:

- a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering circuit breakers and replacement parts.
 - 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the panelboards.
 - 2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

- a. Certification by the manufacturer that the panelboards conform to the requirements of the drawings and specifications.

- b. Certification by the Contractor that the panelboards have been properly installed, adjusted, and tested.

4. APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

- B. International Code Council (ICC):

IBC-12 International Building Code

- C. National Electrical Manufacturers Association (NEMA):

PB 1-11 Panelboards

250-08 Enclosures for Electrical Equipment (1,000V Maximum)

- D. National Fire Protection Association (NFPA):

70-11 National Electrical Code (NEC)

70E-12 Standard for Electrical Safety in the Workplace

- E. Underwriters Laboratories, Inc. (UL):

50-95 Enclosures for Electrical Equipment

67-09 Panelboards

489-09 Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

1. GENERAL REQUIREMENTS

- A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.
- B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.
- C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.
- D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.
- E. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
- F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.

- G. Neutral bus shall be 100% rated, mounted on insulated supports.
- H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.
- I. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 10,000 A symmetrical for 120/208 V and 120/240 V panelboards, and 14,000 A symmetrical for 277/480 V panelboards.
- J. In two-section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panelboards, and have field-installed cable connections to the second section as shown on the drawings. Panelboard sections with tapped bus or crossover bus are not acceptable.
- K. Series-rated panelboards are not permitted.

2. ENCLOSURES AND TRIMS

A. Enclosures:

- 1. Provide galvanized steel enclosures, with NEMA rating as shown on the drawings.
- 2. Enclosures shall not have ventilating openings.
- 3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted.
- 4. Provide manufacturer's standard option for prepunched knockouts on top and bottom endwalls.
- 5. Include removable inner dead front cover, independent of the panelboard cover.

B. Trims:

- 1. Hinged "door-in-door" type.
- 2. Interior hinged door with hand-operated latch or latches, so as to provide access only to circuit breaker operating handles, not to energized parts.
- 3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key or tool for entry. Hand-operated latches are not acceptable.
- 4. Inner and outer doors shall open left to right.
- 5. Trims shall be flush or surface type as shown on the drawings.

3. MOLDED CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.
- B. Circuit breakers shall be bolt-on type.

- C. Circuit breakers shall have minimum interrupting rating to withstand the available fault current, but not less than:
 - 1. 120/208 V Panelboard: 10,000 A symmetrical.
 - 2. 120/240 V Panelboard: 10,000 A symmetrical.
- D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame. Circuit breakers with 400 A frames and above shall have magnetic trip, adjustable from 5x to 10x. Breaker trip setting shall be set in the field. Breaker magnetic trip setting shall be set to maximum, unless otherwise noted.
- E. Circuit breaker features shall be as follows:
 - 1. A rugged, integral housing of molded insulating material.
 - 2. Silver alloy contacts.
 - 3. Arc quenchers and phase barriers for each pole.
 - 4. Quick-make, quick-break, operating mechanisms.
 - 5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
 - 6. Electrically and mechanically trip free.
 - 7. An operating handle which indicates closed, tripped, and open positions.
 - 8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
 - 9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where shown on the drawings.
 - 10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory accordingly.

4. SURGE PROTECTIVE DEVICES

- A. Where shown on the drawings, furnish panelboards with integral surge protective devices.

PART 3 - EXECUTION

5. 3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.

- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- C. In seismic areas, panelboards shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- D. Install a printed schedule of circuits in each panelboard after approval by the Owner. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards
- E. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).
- F. Provide blank cover for each unused circuit breaker mounting space.
- G. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims with finishes to match surrounding surfaces after the panelboards have been installed. Do not paint nameplates.
- H. Rust and scale shall be removed from the inside of existing enclosures where new interior components are to be installed. Paint inside of enclosures with rust-preventive paint before the new interior components are installed. Provide new trim. Trim shall fit tight to the enclosure.

6. ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify appropriate anchorage and required area clearances.
 - d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
 - e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
 - f. Vacuum-clean enclosure interior. Clean enclosure exterior.

7. FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1. DESCRIPTION
 - A. This section specifies the furnishing, installation, connection, and testing of wiring devices.
2. QUALITY ASSURANCE
 - A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
3. SUBMITTALS
 - A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
 3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.
4. APPLICABLE PUBLICATIONS
 - A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
 - B. National Fire Protection Association (NFPA):

70-11 National Electrical Code (NEC)

99-12 Health Care Facilities

C. National Electrical Manufacturers Association (NEMA):

WD 1-10 General Color Requirements for Wiring Devices

WD 6-08 Wiring Devices – Dimensional Specifications

D. Underwriter's Laboratories, Inc. (UL):

5-11 Surface Metal Raceways and Fittings

20-10 General-Use Snap Switches

231-07 Power Outlets

467-07 Grounding and Bonding Equipment

498-07 Attachment Plugs and Receptacles

943-11 Ground-Fault Circuit-Interrupters

1449-07 Surge Protective Devices

1472-96 Solid State Dimming Controls

PART 2 - PRODUCTS

1. RECEPTACLES

A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.

1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.

B. Duplex Receptacles: single phase, 20 ampere, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.

1. Body color shall be as per Owner/Architect.
2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.
3. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, suitable for mounting in a standard outlet box, with end-of-life indication and provisions to isolate the face due to improper wiring.
 - a. Ground fault interrupter shall be consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter

switch. Device shall have nominal sensitivity to ground leakage current of 4-6 milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or – 1 milliampere) on the load side of the device. Device shall have a minimum nominal tripping time of 0.025 second.

4. Safety Type Duplex Receptacles:

a. Body color shall be as per Owner/Architect.

1) Shall permit current to flow only while a standard plug is in the proper position in the receptacle.

2) Screws exposed while the wall plates are in place shall be the tamperproof type.

5. Duplex Receptacles (not hospital grade): Shall be the same as hospital grade duplex receptacles except for the hospital grade listing and as follows.

a. Body color shall be as per Owner/Architect.

C. Receptacles; 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.

D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

2. TOGGLE SWITCHES

A. Toggle switches shall be totally enclosed tumbler type with nylon bodies. Handles color shall be as per Owner/Architect unless otherwise specified or shown on the drawings.

1. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plaster ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.

2. Switches shall be rated 20 amperes at 120-277 Volts AC.

3. MANUAL DIMMING CONTROL

A. Electronic full-wave manual slide dimmer with on/off switch and audible frequency and EMI/RFI suppression filters.

B. Manual dimming controls shall be fully compatible with fluorescent electronic dimming ballasts and approved by the ballast manufacturer, LED dimming driver and be approved by the driver manufacturer, shall operate over full specified

dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.

- C. Provide single-pole or three-way, as shown on the drawings.
- D. Manual dimming control and faceplates color shall as per Owner/Architect.

4. WALL PLATES

- A. Wall plates for switches and receptacles shall be type 302 stainless steel or smooth nylon. Oversize plates are not acceptable.
- B. Color shall be as per Owner/Architect.
- C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- D. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.
- E. Duplex Receptacles on Emergency Circuit: Wall plates shall be red nylon with the word "EMERGENCY" engraved in 6 mm (1/4 inch) white letters.// // Wall plates shall be type 302 stainless steel, with the word "EMERGENCY" engraved in 6 mm (1/4 inch) red letters.//

PART 3 - EXECUTION

5. INSTALLATION

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Install wiring devices after wall construction and painting is complete.
- C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.
- D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.
- E. Provide barriers in multigang outlet boxes to comply with the NEC.
- F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
- G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.
- H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.
- I. Install wall dimmers 1.2 M (48 inches) above floor.

- J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- K. Install vertically mounted receptacles with the ground pin up. Install horizontally mounted receptacles with the ground pin to the right.
- L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.
- M. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

6. ACCEPTANCE CHECKS AND TESTS

- A. Perform manufacturer's required field checks in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Inspect physical and electrical condition.
 - b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.
 - c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
 - d. Test GFCI receptacles.

END OF SECTION 26 27 26

SECTION 26 29 21 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1. DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

2. QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

3. SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:

- a. Submit sufficient information to demonstrate compliance with drawings and specifications.
- b. Submit the following data for approval:
 - 1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.
- c. Certification from the manufacturer that representative enclosed switches and circuit breakers have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:

- a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
 - 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
 - 2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.
4. APPLICABLE PUBLICATIONS
 - A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
 - B. International Code Council (ICC):
IBC-12 International Building Code
 - C. National Electrical Manufacturers Association (NEMA):
FU I-07 Low Voltage Cartridge Fuses
KS I-06 Enclosed and Miscellaneous Distribution Equipment Switches
(600 Volts Maximum)
 - D. National Fire Protection Association (NFPA):
70-11 National Electrical Code (NEC)
 - E. Underwriters Laboratories, Inc. (UL):
98-07 Enclosed and Dead-Front Switches
248-00 Low Voltage Fuses
489-09 Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

1. FUSED SWITCHES RATED 600 AMPERES AND LESS
 - A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.
 - B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.
 - C. Shall be horsepower (HP) rated.
 - D. Shall have the following features:
 1. Switch mechanism shall be the quick-make, quick-break type.
 2. Copper blades, visible in the open position.

3. An arc chute for each pole.
 4. External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
 5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
 6. Fuse holders for the sizes and types of fuses specified.
 7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
 8. Ground lugs for each ground conductor.
 9. Enclosures:
 - a. Shall be the NEMA types shown on the drawings.
 - b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
 - c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.
 10. Electrically operated switches shall only be installed where shown on the drawings.
2. FUSED SWITCHES RATED 600 AMPERES AND LESS
 - A. Shall be the same as fused switches, but without provisions for fuses.
 3. FUSED SWITCHES RATED OVER 600 AMPERES TO 1200 AMPERES
 - A. Shall be the same as fused switches, and shall be NEMA classified Heavy Duty (HD).
 4. MOTOR RATED TOGGLE SWITCHES
 - A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.
 - B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.
 5. CARTRIDGE FUSES
 - A. Shall be in accordance with NEMA FU 1.
 - B. Feeders: Class L, fast acting, Class L, time delay, Class RK1, fast acting, Class RK1, time delay, Class RK5, fast acting, Class RK5, time delay, Class J, fast acting, Class J, time delay.
 - C. Motor Branch Circuits: Class RK1, Class RK5, time delay.
 - D. Other Branch Circuits: Class RK1, time delay, Class RK5, time delay, Class J, fast acting, Class J, time delay.

- E. Control Circuits: Class CC, fast acting, time delay.

6. SEPARATELY-ENCLOSED CIRCUIT BREAKERS

- A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.
- B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

PART 3 - EXECUTION

1. INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. C.Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

2. ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - d. Vacuum-clean enclosure interior. Clean enclosure exterior.

3. SPARE PARTS

- A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the Owner.

END SECTION 26 29 21

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1. DESCRIPTION:
 - A. This section specifies the furnishing, installation, and connection of the interior lighting systems. The terms "lighting fixture," "fixture," and "luminaire" are used interchangeably.
2. QUALITY ASSURANCE
 - A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
3. SUBMITTALS
 - A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 1. Shop Drawings:
 - a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
 - b. Material and construction details, include information on housing and optics system.
 - c. Physical dimensions and description.
 - d. Wiring schematic and connection diagram.
 - e. Installation details.
 - f. Energy efficiency data.
 - g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.
 - h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).
 - i. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).
 - j. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.
 2. Manuals:

- a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
 3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the Contractor that the interior lighting systems have been properly installed and tested.
4. APPLICABLE PUBLICATIONS
 - A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
 - B. American National Standards Institute (ANSI):
C78.1-91 Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
C78.376-01 Chromaticity of Fluorescent Lamps
 - C. American Society for Testing and Materials (ASTM):
C635-07 Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - D. Environmental Protection Agency (EPA):
40 CFR 261 Identification and Listing of Hazardous Waste
 - E. Federal Communications Commission (FCC):
CFR Title 47, Part 15 Radio Frequency Devices
CFR Title 47, Part 18 Industrial, Scientific, and Medical Equipment
 - F. Illuminating Engineering Society (IES):
LM-79-08 Electrical and Photometric Measurements of Solid-State Lighting Products
LM-80-08 Measuring Lumen Maintenance of LED Light Sources
LM-82-12 Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature

- G. Institute of Electrical and Electronic Engineers (IEEE):
 - C62.41-91 Surge Voltages in Low Voltage AC Power Circuits
- H. International Code Council (ICC):
 - IBC-12 International Building Code
- I. National Fire Protection Association (NFPA):
 - 70-11 National Electrical Code (NEC)
 - 101-12 Life Safety Code
- J. National Electrical Manufacturer's Association (NEMA):
 - C82.1-04 Lamp Ballasts – Line Frequency Fluorescent Lamp Ballasts
 - C82.2-02 Method of Measurement of Fluorescent Lamp Ballasts
 - C82.4-02 Lamp Ballasts - Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)
 - C82.11-11 Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts
 - LL-9-09 Dimming of T8 Fluorescent Lighting Systems
 - SSL-1-10 Electronic Drivers for LED Devices, Arrays, or Systems
- K. Underwriters Laboratories, Inc. (UL):
 - 496-08 Lampholders
 - 542-0599 Fluorescent Lamp Starters
 - 844-12 Luminaires for Use in Hazardous (Classified) Locations
 - 924-12 Emergency Lighting and Power Equipment
 - 935-01 Fluorescent-Lamp Ballasts
 - 1029-94 High-Intensity-Discharge Lamp Ballasts
 - 1029A-06 Ignitors and Related Auxiliaries for HID Lamp Ballasts
 - 1598-08 Luminaires
 - 1574-04 Track Lighting Systems
 - 2108-04 Low-Voltage Lighting Systems
 - 8750-09 Light Emitting Diode (LED) Light Sources for Use in Lighting Products

PART 2 - PRODUCTS

1. LIGHTING FIXTURES

- A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.
- B. Sheet Metal:
 - 1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
 - 2. Wireways and fittings shall be free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.
 - 3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
 - 4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.
- C. Ballasts and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.
- D. Lamp Sockets:
 - 1. Fluorescent: Single slot entry type, requiring a one-quarter turn of the lamp after insertion. Lampholder contacts shall be the biting edge type.
 - 2. Compact Fluorescent: 4-pin.
 - 3. High Intensity Discharge (HID): Porcelain.
- E. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- F. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- G. Metal Finishes:
 - 1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
 - 2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.

3. Exterior finishes shall be as shown on the drawings.
 - H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
 - I. Light Transmitting Components for Fluorescent Fixtures:
 1. Shall be 100 percent virgin acrylic.
 2. Flat lens panels shall have not less than 3 mm (1/8 inch) of average thickness.
 3. Unless otherwise specified, lenses, reflectors, diffusers, and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction without distortion or cracking.
 - J. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Division areas as defined in NFPA 70.
 - K. Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballast integral to the fixture. Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures.
2. BALLASTS
- A. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 – 277V), electronic, instant-start type, designed for type and quantity of lamps indicated. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated. Ballasts shall include the following features:
 1. Lamp end-of-life detection and shutdown circuit (T5 lamps only).
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: Class A.
 4. Total Harmonic Distortion (THD): 10 percent or less.
 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. Ballast Factor: 0.87 or higher unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
 10. EMR/RFI Interference: Comply with CFR Title 47 Part 18 for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

11. To facilitate multi-level lamp switching, lamps within fixture shall be wired with the outermost lamp at both sides of the fixture on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled.
 12. Where three-lamp fixtures are indicated, unless switching arrangements dictate otherwise, utilize a common two-lamp ballast to operate the center lamp in pairs of adjacent units that are mounted in a continuous row. The ballast fixture and slave-lamp fixture shall be factory wired with leads or plug devices to facilitate this circuiting. Individually mounted fixtures and the odd fixture in a row shall utilize a single-lamp ballast for operation of the center lamp.
 13. Dimming ballasts shall be as per above, except dimmable from 100% to 5% of rated lamp lumens. Dimming ballasts shall be fully compatible with the dimming controls.
- B. Low-Frequency Linear T8 Fluorescent Lamp Ballasts (allowed for Surgery Suites, Critical Care Units, and Animal Labs): Multi-voltage (120 – 277V), hybrid electronic-electromagnetic rapid-start type, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output. Ballasts shall include the following features:
1. Automatic lamp starting after lamp replacement.
 2. Sound Rating: Class A.
 3. Total Harmonic Distortion (THD): 20 percent or less.
 4. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 5. Operating Frequency: 60 Hz.
 6. Lamp Current Crest Factor: 1.7 or less.
 7. Ballast Factor: 0.85 or higher unless otherwise indicated.
 8. Power Factor: 0.90 or higher.
 9. Interference: Comply with CFR Title 47 Part 18 for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
 10. To facilitate multi-level lamp switching, lamps within fixture shall be wired with the outermost lamp at both sides of the fixture on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled.
 11. Where three-lamp fixtures are indicated, unless switching arrangements dictate otherwise, utilize a common two-lamp ballast to operate the center

lamp in pairs of adjacent units that are mounted in a continuous row. The ballast fixture and slave-lamp fixture shall be factory wired with leads or plug devices to facilitate this circuiting. Individually mounted fixtures and the odd fixture in a row shall utilize a single-lamp ballast for operation of the center lamp.

- C. Compact Fluorescent Lamp Ballasts: Multi-voltage (120 – 277V), electronic programmed rapid-start type, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated. Ballasts shall include the following features:
1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: Class A.
 4. Total Harmonic Distortion (THD): 10 percent or less.
 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. Ballast Factor: 0.95 or higher unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
 10. Interference: Comply with CFR Title 47 Part 18 for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
 11. Dimming ballasts shall be as per above, except dimmable from 100% to 5% of rated lamp lumens. Dimming ballasts shall be fully compatible with the dimming controls.
- D. Ballasts for HID fixtures: Multi-tap voltage (120 – 480V) electromagnetic ballast for high intensity discharge lamps. Include the following features unless otherwise indicated:
1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
 3. Rated Ambient Operating Temperature: 104 deg F (40 deg C).
 4. Open-circuit operation that will not reduce average life.
 5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

- E. Electronic ballast for HID metal-halide lamps shall include the following features unless otherwise indicated:

1. Minimum Starting Temperature: Minus 20 deg F (Minus 29 deg C) for single-lamp ballasts.
2. Rated Ambient Operating Temperature: 130 deg F (54 deg C).
3. Lamp end-of-life detection and shutdown circuit.
4. Sound Rating: Class A.
5. Total Harmonic Distortion (THD): 20 percent or less.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Lamp Current Crest Factor: 1.5 or less.
8. Power Factor: 0.90 or higher.
9. Interference: Comply with CFR Title 47 Part 18 for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
10. Protection: Resettable thermal.

3. FLUORESCENT EMERGENCY BALLAST

- A. Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture housing and compatible with ballast.

1. Emergency Connection: Operate fluorescent lamp(s) continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
3. Battery: Sealed, maintenance-free, nickel-cadmium type.
4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
5. Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

4. EMERGENCY LIGHTING UNIT

- A. Complete, self-contained unit with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, and test switch.
1. Enclosure: Shall be impact-resistant thermoplastic, cast aluminum. Enclosure shall be suitable for the environmental conditions in which installed.
 2. Lamp Heads: Horizontally and vertically adjustable, mounted on the face of the unit, except where otherwise indicated.
 3. Lamps: Shall be sealed-beam MR-16 halogen, rated not less than 12 watts at the specified DC voltage.
 4. Battery: Shall be maintenance-free nickel-cadmium. Minimum normal life shall be minimum of 10 years.
 5. Battery Charger: Dry-type full-wave rectifier with charging rates to maintain the battery in fully-charged condition during normal operation, and to automatically recharge the battery within 12 hours following a 1-1/2 hour continuous discharge.
 6. Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

5. LAMPS

A. Linear and U-shaped T5 and T8 Fluorescent Lamps:

1. Except as indicated below, lamps shall be low-mercury energy saving type, have a color temperature between 3500° and 4100°K, a Color Rendering Index (CRI) equal or greater than 80, average rated life equal to or greater than 24,000 hours when used with an instant start ballast and 30,000 hours when used with a programmed or rapid start ballast (based on 3 hour starts), and be suitable for use with dimming ballasts, unless otherwise indicated.
 - a. Over the beds in Intensive Care, Coronary Care, Recovery, Life Support, and Observation and Treatment areas; Electromyographic, Autopsy (Necropsy), Surgery, and certain dental rooms (Examination, Oral Hygiene, Oral Surgery, Recovery, Labs, Treatment, and X-Ray) use color corrected lamps having a CRI of 85 or above and a correlated color temperature between 5000 and 6000°K, as shown on the drawings.
 - b. Other areas as shown on the drawings.
2. Lamps shall comply with EPA Toxicity Characteristic Leachate Procedure (TCLP) requirements.

B. Compact Fluorescent Lamps:

1. T4, CRI 80 (minimum), color temperature 3500°K, average rated life equal to or greater than 12,000 hours (based on 3 hour starts), and suitable for use with dimming ballasts, unless otherwise indicated.
 2. Lamps shall comply with EPA Toxicity Characteristic Leachate Procedure (TCLP) requirements.
- C. High Intensity Discharge Lamps:
1. High-Pressure Sodium Lamps: CRI 21 (minimum), color temperature 1900°K, and average rated life of 24,000 hours.
 - a. Lamps shall comply with EPA Toxicity Characteristic Leachate Procedure (TCLP) requirements.
 2. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65 (minimum), color temperature 4000°K, and average rated life of 15,000 hours (based on 10 hour starts).
 3. Ceramic, Pulse-Start, Metal-Halide Lamps: CRI 80 (minimum), color temperature 4000°K, and average rated life of 12,000 hours (based on 10 hour starts).
6. LED EXIT LIGHT FIXTURES
- A. Exit light fixtures shall meet applicable requirements of NFPA and UL.
 - B. Housing and door shall be die-cast aluminum.
 - C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
 - D. Finish shall be satin or fine-grain brushed aluminum.
 - E. There shall be no radioactive material used in the fixtures.
 - F. Fixtures:
 1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
 2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
 3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.
 - G. Voltage: Multi-voltage (120 – 277V).

7. LED LIGHT FIXTURES

A. General:

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:
 - a. Minimum efficiency: 85% at full load.
 - b. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
 - c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
 - d. Integral short circuit, open circuit, and overload protection.
 - e. Power Factor: ≥ 0.95.
 - f. Total Harmonic Distortion: ≤ 20%.
 - g. Comply with FCC 47 CFR Part 15.
4. LED modules shall include the following features unless otherwise indicated:
 - a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum CRI 80 and color temperature 3000° K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - c. Minimum Rated Life: 50,000 hours per IES L70.
 - d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

B. LED Downlights:

1. Housing, LED driver, and LED module shall be products of the same manufacturer.

C. LED Troffers:

1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
2. Housing, LED driver, and LED module shall be products of the same manufacturer.

PART 3 - EXECUTION

1. INSTALLATION

- A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings or specified.
- B. Align, mount, and level the lighting fixtures uniformly.
- C. Wall-mounted fixtures shall be attached to the studs in the walls, or to a 20 gauge metal backing plate that is attached to the studs in the walls. Lighting fixtures shall not be attached directly to gypsum board.
- D. Lighting Fixture Supports:
 - 1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Shall maintain the fixture positions after cleaning and relamping.
 - 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
 - 4. Hardware for recessed fluorescent fixtures:
 - a. Where the suspended ceiling system is supported at the four corners of the fixture opening, hardware devices shall clamp the fixture to the ceiling system structural members, or plaster frame at not less than four points in such a manner as to resist spreading of the support members and safely lock the fixture into the ceiling system.
 - b. Where the suspended ceiling system is not supported at the four corners of the fixture opening, hardware devices shall independently support the fixture from the building structure at four points.
 - 5. Hardware for surface mounting fluorescent fixtures to suspended ceilings:
 - a. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 6 mm (1/4 inch) secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
 - b. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 6 mm (1/4 inch) studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 6 mm (1/4 inch) toggle bolts may be used on new or

existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.//

6. Hardware for recessed lighting fixtures:
 - a. All fixture mounting devices connecting fixtures to the ceiling system or building structure shall have a capacity for a horizontal force of 100 percent of the fixture weight and a vertical force of 400 percent of the fixture weight.
 - b. Mounting devices shall clamp the fixture to the ceiling system structure (main grid runners or fixture framing cross runners) at four points in such a manner as to resist spreading of these supporting members. Each support point device shall utilize a screw or approved hardware to "lock" the fixture housing to the ceiling system, restraining the fixture from movement in any direction relative to the ceiling. The screw (size No. 10 minimum) or approved hardware shall pass through the ceiling member (T-bar, channel or spline), or it may extend over the inside of the flange of the channel (or spline) that faces away from the fixture, in a manner that prevents any fixture movement.
 - c. In addition to the above, the following is required for fixtures exceeding 9 kg (20 pounds) in weight.
 - 1) Where fixtures mounted in ASTM Standard C635 "Intermediate Duty" and "Heavy Duty" ceilings and weigh between 9 kg and 25 kg (20 pounds and 56 pounds), provide two 12 gauge safety hangers hung slack between diagonal corners of the fixture and the building structure.
 - 2) Where fixtures weigh over 25 kg (56 pounds), they shall be independently supported from the building structure by approved hangers. Two-way angular bracing of hangers shall be provided to prevent lateral motion.
 - d. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
7. Surface mounted lighting fixtures:
 - a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 6 mm (1/4 inch) bolt, secured to main ceiling runners and/or secured to cross runners. Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12 gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 25 kg (56 pounds) shall be supported directly from the building structure.

- b. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
 - c. Fixtures less than 6.8 kg (15 pounds) in weight and occupying less than 3715 sq cm (two square feet) of ceiling area may, when designed for the purpose, be supported directly from the outlet box when all the following conditions are met.
 - 1) Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.
 - 2) The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.
 - 3) The outlet box is supported vertically from the building structure.
 - d. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.
 - 8. Single or double pendant-mounted lighting fixtures:
 - a. Each stem shall be supported by an approved outlet box mounted swivel joint and canopy which holds the stem captive and provides spring load dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.
 - 9. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.
 - E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.
 - F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.
 - G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
 - H. Dispose of lamps per local requirements

2. ACCEPTANCE CHECKS AND TESTS

 - A. Perform the following:
 - 1. Visual Inspection:
 - a. Verify proper operation by operating the lighting controls.

- b. Visually inspect for damage to fixtures, lenses, reflectors, diffusers, and louvers. Clean fixtures, lenses, reflectors, diffusers, and louvers that have accumulated dust, dirt, or fingerprints during construction.

2. Electrical tests:

- a. Exercise dimming components of the lighting fixtures over full range of dimming capability by operating the control devices(s) in the presence of the Owner. Observe for visually detectable flicker over full dimming range, and replace defective components at no cost.
- b. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy. Burn-in period to be 40 hours minimum, unless specifically recommended otherwise by the lamp manufacturer. Burn-in dimmed fluorescent and compact fluorescent lamps for at least 100 hours at full voltage, unless specifically recommended otherwise by the lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.

3. FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

END OF SECTION 26 51 00

SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 - GENERAL

1. DESCRIPTION
 - A. This section specifies the furnishing, installation, and connection of exterior luminaires, poles, and supports.
2. QUALITY ASSURANCE
 - A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
3. SUBMITTALS
 - A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - B. Shop Drawings:
 1. Clearly present sufficient information to determine compliance with drawings and specifications.
 2. Include electrical ratings, dimensions, mounting, details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, poles, luminaires, lamps, and accessories. Include electronic photometric files in IES format, or provide link (URL) to manufacturer's website that contains photometric data for each specific fixture used, excluding wallpack fixtures.
 - C. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the Owner. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement lamps, ballasts, and parts.
 - D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Owner.
 1. Certification by the manufacturer that the materials are in accordance with the drawings and specifications.
 2. Certification by the contractor that the complete installation has been properly installed and tested.
4. APPLICABLE PUBLICATIONS
 - A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
 - B. Aluminum Association Inc. (AA):
AAH35.1-06.....Alloy and Temper Designation Systems for Aluminum

- C. American Association of State Highway and Transportation Officials (AASHTO):
 - LTS-5-09 Structural Supports for Highway Signs, Luminaires and Traffic Signals
- D. American Concrete Institute (ACI):
 - 318-05 Building Code Requirements for Structural Concrete
- E. American National Standards Institute (ANSI):
 - C81.61-09 Electrical Lamp Bases – Specifications for Bases (Caps) for Electric Lamps
- F. American Society for Testing and Materials (ASTM):
 - A123/A123M-09 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - A153/A153M-09 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - B108-03a-08 Aluminum-Alloy Permanent Mold Castings
 - C1089-06 Spun Cast Prestressed Concrete Poles
- G. Federal Aviation Administration (FAA):
 - AC 70/7460-IK-07 Obstruction Lighting and Marking
 - AC 150/5345-43F-06 Obstruction Lighting Equipment
- H. Illuminating Engineering Society of North America (IESNA)
 - HB-9-00 Lighting Handbook
 - RP-8-05 Roadway Lighting
 - RP-20-98 Lighting for Parking Facilities
 - RP-33-99 Lighting for Exterior Environments
 - LM-5-96 Photometric Measurements of Area and Sports Lighting Installations
 - LM-50-99 Photometric Measurements of Roadway Lighting Installations
 - LM-52-99 Photometric Measurements of Roadway Sign Installations
 - LM-64-01 Photometric Measurements of Parking Areas
 - LM-72-97 Directional Positioning of Photometric Data
 - LM-79-08 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

LM-80-08 Approved Method for Measuring Lumen Maintenance of LED
Light Sources

I. National Electrical Manufacturers Association (NEMA):

C78.41-06 Electric Lamps – Guidelines for Low-Pressure Sodium Lamps

C78.42-07 Electric Lamps – Guidelines for High-Pressure Sodium Lamps

C78.43-07 Electric Lamps – Single-Ended Metal-Halide Lamps

C78.1381-98 Electric Lamps – 70-Watt M85 Double-Ended Metal-Halide
Lamps

C82.4-02 Ballasts for High-Intensity-Discharge and Low-Pressure Sodium
Lamps (Multiple-Supply Type)

C136.3-05 For Roadway and Area Lighting Equipment – Luminaire
Attachments

C136.17-05 Roadway and Area Lighting Equipment – Enclosed Side-
Mounted luminaires for Horizontal-Burning High-Intensity-
Discharge Lamps – Mechanical Interchangeability of
Refractors

ICS 2-00 (R2005) Controllers, Contactors and Overload Relays Rated 600 Volts

ICS 6-93 (R2006) Enclosures

J. National Fire Protection Association (NFPA):

70-08 National Electrical Code (NEC)

K. Underwriters Laboratories, Inc. (UL):

496-08 Lampholders

773-95 Plug-In, Locking Type Photocontrols for Use with Area Lighting

773A-06 Nonindustrial Photoelectric Switches for Lighting Control

1029-94 High-Intensity-Discharge Lamp Ballasts

1598-08 Luminaires

8750-08 Light Emitting Diode (LED) Light Sources for Use in Lighting Products

5. DELIVERY, STORAGE, AND HANDLING

- A. Provide manufacturer's standard provisions for protecting pole finishes during transport, storage, and installation. Do not store poles on ground. Store poles so they are at least 12 in [305 mm] above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 - PRODUCTS

1. MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

2. POLES

A. General:

1. Poles shall be as shown on the drawings, and as specified. Finish shall be as specified on the drawings.
2. The pole and arm assembly shall be designed for wind loading of 100 mph , with an additional 30% gust factor, supporting luminaire(s) and accessories such as shields, banner arms, and banners that have the effective projected areas indicated. The effective projected area of the pole shall be applied at the height of the pole base, as shown on the drawings.
3. Poles shall be embedded, anchor-bolt type designed for use with underground supply conductors. Poles shall have handhole having a minimum clear opening of 2.5 x 5 in. Handhole covers shall be secured by stainless steel captive screws.
4. Provide a steel-grounding stud opposite handhole openings, designed to prevent electrolysis when used with copper wire.
5. Provide a base cover that matches the pole in material and color to conceal the mounting hardware pole-base welds and anchor bolts.
6. Hardware and Accessories: All necessary hardware and specified accessories shall be the product of the pole manufacturer.
7. Provide manufacturer's standard finish, as scheduled on the drawings.

B. Pole Types:

1. Aluminum: Provide round, square aluminum poles manufactured of corrosion-resistant AA AAH35.1 aluminum alloys conforming to AASHTO LTS-4. Poles shall be seamless extruded or spun seamless type.
2. Steel: Provide round, square steel poles having minimum 11-gauge steel with minimum yield/strength of 48,000 psi and hot-dipped galvanized, iron-oxide primed factory finish. Galvanized steel poles shall comply with ASTM A123 and A153.

3. FOUNDATIONS FOR POLES

- A. Foundations shall be cast-in-place concrete, having 3000 psi minimum 28-day compressive strength.

- B. Foundations shall support the effective projected area of the specified pole, arm(s), luminaire(s), and accessories, such as shields, banner arms, and banners, under wind conditions previously specified in this section.
- C. Place concrete in spirally-wrapped treated paper forms for round foundations, and construct forms for square foundations.
- D. Rub-finish and round all above-grade concrete edges to approximately 0.25 in [6 mm] radius.
- E. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on the drawings. Anchor bolts shall be in a welded cage or properly positioned by the tie wire to stirrups.
- F. Prior to concrete pour, install electrode per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

4. LUMINAIRES

- A. Per UL 1598 and NEMA C136.17. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat, and safe cleaning and relamping.
- B. Light distribution pattern types shall be as shown on the drawings.
- C. Incorporate ballasts in the luminaire housing, except where otherwise shown on the drawings.
- D. Lenses shall be frame-mounted, heat-resistant, borosilicate glass, with prismatic refractors, unless otherwise shown on the drawings. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Lamp sockets for high intensity discharge (H.I.D) fixture shall have locking-type porcelain enclosures in conformance to the applicable requirements of ANSI C81.61 and UL 496.
- F. Pre-wire internal components to terminal strips at the factory.
- G. Bracket-mounted luminaires shall have leveling provisions and clamp-type adjustable slip-fitters with locking screws.
- H. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- I. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, match finish process and color of pole or support materials.
- J. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

5. LAMPS

- A. Install the proper lamps in every luminaire installed and every existing luminaire relocated or reinstalled.

- B. Lamps shall be general-service, outdoor lighting types.
- C. High-Pressure Sodium (HPS) Lamps: NEMA C78.42, CRI 21 (minimum), wattage as indicated. Lamps shall have minimum average rated life of 24,000 hours.
- D. Metal-Halide Lamps: NEMA C78.43 or NEMA C78.1381.
- E. LED sources shall meet the following requirements:
 - 1. Operating temperature rating shall be between -40° F [-40° C] and 120° F [50° C].
 - 2. Color Rendering Index (CRI): ≥ 65 .
 - 3. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).//

6. HIGH INTENSITY DISCHARGE BALLASTS

- A. Per NEMA C82.4 and UL 1029. Ballasts shall be //encapsulated// single-lamp, copper-wound, constant-wattage autotransformer type, designed to operate on the voltage system to which they are connected, and capable of open-circuit operation without reducing lamp life.
- B. Ballasts shall have individual overcurrent protection in each ungrounded supply conductor.
- C. Ballast shall have an allowable line voltage variations of $\pm 10\%$, with a maximum 20% lamp wattage regulation spread.
- D. Power factor shall be not less than 90%.
- E. Ballast shall have a minimum starting temperature of -22° F [-30° C], and a normal ambient operating temperature of 104° F [40° C].
- F. Lamp current crest factor shall be 1.8 or less, in accordance with lamp manufacturer recommendations.

7. METAL HALIDE CORE AND COIL BALLASTS

- A. Shall be pulse start, linear reactor type for 277 volt luminaires and constant-wattage autotransformer (CWA) type for other voltage luminaires (if not otherwise specified).
- B. Ballasts shall have individual overcurrent protection in each ungrounded supply conductor.
- C. Power factor shall be not less than 90%.
- D. Ballast shall have an allowable line voltage variations of $\pm 5\%$ for linear reactor type and $\pm 10\%$ for CWA, with a maximum 20% lamp wattage regulation spread.

- E. Ballast shall have a minimum starting temperature of -40° F [-40° C].
- F. Lamp current crest factor shall be 1.8 or less, in accordance with lamp manufacturer recommendations.

8. 2.8 METAL HALIDE ELECTRONIC BALLASTS

- A. Ballast shall be low-frequency electronic type, and shall operate pulse start and ceramic metal halide lamps at a frequency of 90 to 200 Hz square wave.
- B. Ballast shall be labeled Type '1' outdoor, suitable for recessed use, Class 'P'.
- C. Ballast shall have auto-resetting thermal protector to shut off ballast when operating temperatures reach unacceptable levels.
- D. Ballast shall have an end of lamp life detection and shut-down circuit.
- E. Lamp current crest factor shall be 1.5 or less.
- F. Ballasts shall comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
- G. Ballast shall have a minimum ballast factor of 1.0.
- H. Input current THD shall not exceed 20% for the primary lamp.
- I. Ballasts shall have ANSI C62.41, category 'A' transient protection.
- J. Ballasts shall have power factor greater than 90%.
- K. Ballast shall have a Class 'A' sound rating.

9. LED DRIVERS

- A. LED drivers shall meet the following requirements:
 - 1. Drivers shall have a minimum efficiency of 85%.
 - 2. Starting Temperature: -40° F [-40° C].
 - 3. Input Voltage: 120 to 480 ($\pm 10\%$) V.
 - 4. Power Supplies: Class I or II output.
 - 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: $6\text{ kV}/1.2 \times 50 \mu\text{s}$, $10\text{ kA}/8 \times 20 \mu\text{s}$) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 - 6. Power Factor (PF): ≥ 0.90 .
 - 7. Total Harmonic Distortion (THD): $\leq 20\%$.

8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

PART 3 - EXECUTION

1. INSTALLATION

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Pole Foundations:
 1. Excavate only as necessary to provide sufficient working clearance for installation of forms and proper use of tamper to the full depth of the excavation. Prevent surface water from flowing into the excavation. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath, and the end of conduit.
 2. Set anchor bolts according to anchor-bolt templates furnished by the pole manufacturer.
 3. Install poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.
 4. After the poles have been installed, shimmed, and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 0.375 in [9 mm] inside diameter through the grout, tight to the top of the concrete base to prevent moisture weeping from the interior of the pole.
- C. Install lamps in each luminaire.
- D. Adjust luminaires that require field adjustment or aiming.

2. GROUNDING

- A. Ground noncurrent-carrying parts of equipment, including metal poles, luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially-treated or lined connectors suitable and listed for this purpose.

3. ACCEPTANCE CHECKS AND TESTS

- A. Verify operation after installing luminaires and energizing circuits.

END OF SECTION 26 56 00

SECTION 28 31 11 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1. SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Nonsystem smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Magnetic door holders.
8. Remote annunciator.
9. Addressable interface device.
10. Digital alarm communicator transmitter.

2. DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

3. SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.
- B. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

4. ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 2. Include voltage drop calculations for notification appliance circuits.
 3. Include battery-size calculations.
 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke

detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.

6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

5. QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

6. SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

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. Fire Control Instruments, Inc.; a Honeywell company.
 2. EST
 3. Fire Lite Alarms; a Honeywell company.
 4. NOTIFIER; a Honeywell company.
 5. SimplexGrinnell LP; a Tyco International company.
2. All visible fire alarm devices that are allowed to be by code shall be white in color. Coordinate in architect for more information.
3. SYSTEMS OPERATIONAL DESCRIPTION
- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
1. Manual stations.
 2. Heat detectors.
 3. Smoke detectors.
 4. Duct smoke detectors.
 5. Verified automatic alarm operation of smoke detectors.
 6. Automatic sprinkler system water flow.
 7. Fire-extinguishing system operation.
 8. Fire standpipe system.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
 2. Identify alarm at fire-alarm control unit and remote annunciators.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Release fire and smoke doors held open by magnetic door holders.
 5. Activate voice/alarm communication system.
 6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 8. Recall elevators to primary or alternate recall floors.
 9. Activate emergency lighting control.
 10. Activate emergency shutoffs for gas and fuel supplies.
 11. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Elevator shunt-trip supervision.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.

6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
 9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.
4. FIRE-ALARM CONTROL UNIT
- A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 80 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
 2. Serial Interfaces: Two RS-232 ports for printers.
- D. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.

2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

E. Elevator Recall:

1. Smoke detectors at the following locations shall initiate automatic elevator recall.
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detectors in elevator hoistway.
2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

5. MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

6. SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 deg F per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 155 deg F.
 - c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

7. HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

8. NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.
- B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
 - 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, white.

9. MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
 - 1. Electromagnet: Requires no more than 3 W to develop **25-lbf** holding force.
 - 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
 - 3. Rating: 24-V ac or dc.
 - 4. Rating: 120-V ac.
- B. Material and Finish: Match door hardware.

10. REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush cabinet, NEMA 250, Type 1.
 - B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
11. ADDRESSABLE INTERFACE DEVICE
- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
 - B. Integral Relay: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown.
12. DIGITAL ALARM COMMUNICATOR TRANSMITTER
- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
 - B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
 - C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or fire-alarm control unit.
 - D. Digital data transmission shall include the following:
 - 1. Address of the alarm-initiating device.
 - 2. Address of the supervisory signal.
 - 3. Address of the trouble-initiating device.
 - 4. Loss of ac supply or loss of power.
 - 5. Low battery.
 - 6. Abnormal test signal.
 - 7. Communication bus failure.
 - E. Secondary Power: Integral rechargeable battery and automatic charger.

- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

1. EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- C. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed 30 feet.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
 - 5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.
- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- F. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- G. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.
- H. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- I. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
- J. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

2. CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device

controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated air-conditioning duct systems.
2. Alarm-initiating connection to elevator recall system and components.
3. Alarm-initiating connection to activate emergency lighting control.
4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
5. Supervisory connections at valve supervisory switches.
6. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
7. Supervisory connections at elevator shunt trip breaker.

3. IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.
- B. Install framed instructions in a location visible from fire-alarm control unit.

4. GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

5. DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection (if applicable) measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect remaining trees and shrubs from damage and maintain vegetation. Employ a licensed arborist to repair tree and shrub damage. Restore damaged vegetation. Replace damaged trees that cannot be restored to full growth, as determined by arborist.
- D. Do not store materials or equipment or permit excavation within drip line of remaining trees.
- E. Protect site improvements to remain from damage. Restore damaged improvements to condition existing before start of site clearing.
- F. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- G. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.

3.2 SITE CLEARING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
 - 1. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 2. Chip brush, branches, and trees and dispose of off-site.

- B. Strip topsoil. Remove sod and grass before stripping topsoil. Stockpile topsoil that will be reused in the Work.
 - 1. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.
- C. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- D. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Neatly saw-cut length of existing pavement to remain before removing existing pavement.
- E. Dispose of waste materials, including trash, debris, and excess topsoil, off Owner's property. Burning waste materials on-site is not permitted.
 - 1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 31 10 00

SECTION 31 21 13 – RADON CONTROL

PART 1 - DESCRIPTION

1.1 All residential buildings shall be provided with radon-resistant features in accordance with:

ASTM E1465–08a, *Standard Practice for Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings* for installation of passive systems.

1.2 Radon Zones 2 and 3

A. Construction requirements:

1. Gas Permeable Layer: The coarse aggregate permeable layer below the concrete slabs that would carry any radon away from the structure's interior shall meet all of the requirements of ASTM E 1465-08a, Section 6.4 (or similar section in most recent edition).
2. Ground Cover: The concrete slabs and plastic membranes that seal the top of the gas permeable layer shall meet all the requirements of ASTM E 1465-08a, Section 6.2 (or similar section in the most recent edition).
3. Foundation Walls: Foundation walls shall meet all of the requirements of ASTM E 1465-08a, Section 6.3 (or similar section in the most recent edition).

B. Post-construction testing is required, except as provided at IV.A.3

1. Radon testing must be performed after construction is complete, but prior to Final Endorsement.
2. If testing results are at or above the threshold, retrofit based on ASTM E2121-11 (or most recent edition) is required, with installation of a passive system. If testing results remain above the threshold, a fan-powered system pursuant to ASTM E 1456-08a (or most recent edition) is required.

END OF SECTION 31 21 13

SECTION 31 31 16 - TERMITE CONTROL

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and product certificates. Include the EPA-Registered Label.
- B. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who is accredited by manufacturer.

PART 2 - PRODUCTS

2.1 TERMITE CONTROL PRODUCTS

- A. Regulatory Requirements: Provide EPA-registered termiticides and termiticide devices formulated and applied according to the EPA-Registered Label.
- B. Soil Treatment Termiticide: Provide termiticide complying with requirements of authorities having jurisdiction, in an aqueous solution.
 - 1. Products:
 - a. BASF Corporation, Agricultural Products; Termidor.
 - b. Bayer Environmental Science; Premise 75.
 - c. Ensystem, Inc.
 - d. Syngenta; Demon TC, Prelude, Probuild TC.
 - 2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.
- B. Soil Treatment Application: Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction:
 - 1. At foundations.
 - 2. Under concrete floor slabs-on-grade.
 - 3. Under basement floor slabs.
 - 4. At hollow masonry.
 - 5. At expansion and control joints and slab penetrations.
 - 6. At crawlspaces; treat soil under and adjacent to foundations. Treat adjacent areas including around entrance platform, porches, and equipment bases.
- C. Post warning signs in areas of soil treatment application.
- D. Reapply soil termiticide treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

- E. Wood Treatment Application: Provide quantity of borate solution required for application at the label volume and rate for the maximum specified concentration of borate so that wood framing, sheathing, siding, and structural members subject to infestation receive treatment.

END OF SECTION 31 31 16

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and design mixtures for concrete.

PART 2 - PRODUCTS

2.1 CONCRETE PAVING

- A. Comply with ACI 301 unless otherwise indicated.

2.2 MATERIALS

- A. Welded Wire Reinforcement: ASTM A 185, flat sheets.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- C. Portland Cement: ASTM C 150, Type I or II, Supplement with the following:
 - 1. Fly Ash: ASTM C 618, Type C or F.
- D. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, uniformly graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Chemical Admixtures: ASTM C 494. Calcium chloride shall not be used.
- G. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.
- H. Pavement-Marking Paint: MPI #97 latex traffic marking paint.
 - 1. Color: As indicated.

2.3 CONCRETE MIXTURES

- A. Proportion normal-weight concrete mixes to provide the following properties:
 - 1. Compressive Strength (28 Days): 3500 psi.
 - 2. Slump Limit: 4 inches to 6 inches.
 - 3. Air Content: 5 percent plus or minus 1.0 percent.

PART 3 - EXECUTION

3.1 PAVING

- A. Accurately position and support reinforcement, and secure against displacement.
- B. Locate and install contraction, construction, isolation, and expansion joints as indicated or required. Saw-cut control joints shall be spaced 15-feet on center at a maximum.
- C. Place concrete in a continuous operation within planned joints or sections. Do not add water to adjust slump.

- D. Float surfaces to true planes within a tolerance of 1/4 inch in 10 feet and medium-to-coarse-textured broom finish.
- E. Tool edges and joints to a radius of 3/8 inch.
- F. Stamped Detectable Warnings: Install stamped detectable warnings according to stamp-mat manufacturer's written instructions. Accurately align and place stamp mats in sequence. Press mats into concrete to produce imprint pattern on concrete surface, then remove stamp mats.
- G. Begin curing after finishing concrete. Keep concrete continuously moist for at least seven days.
- H. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
- I. Apply traffic paint with mechanical equipment to a minimum wet film thickness of 15 mils.
- J. Owner will engage a qualified testing agency to perform tests and inspections.
- K. Remove and replace concrete paving that is broken, damaged, or defective. Remove work in complete sections from joint to joint unless otherwise approved by Owner.
- L. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days.

END OF SECTION 32 13 13

SECTION 32 31 19 - DECORATIVE METAL FENCES AND GATES

GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PRODUCTS

1.2 DECORATIVE ALUMINUM FENCES

- A. Decorative Aluminum Fences: Fences made from aluminum extrusions.
- B. Basis-of-design product is: Montage Plus by Ameristar Fence Products.
 - 1. Manufacturers:
 - a. Alumi-Guard, Inc.
 - b. Ameristar Fence Products.
 - c. Carfaro, Inc.
 - d. Delair Group, L.L.C.
 - e. Elegant Aluminum Products, Inc.
 - f. Elite Fence Products, Inc.
 - g. Iron Eagle Industries, Inc.
 - h. Japra Group International.
 - i. Jerith Manufacturing Company, Inc.
 - j. Master Halco.
 - k. Merchants Metals; a division of MMI Products, Inc.
 - l. Royal Aluminum and Steel, Inc.
 - m. Specrail; a division of Porcelen LLC.
- C. Posts: Square extruded tubes, 2 by 2 inches with 16ga. wall thickness.
- D. Post Caps: Aluminum castings.
- E. Rails: Extruded-aluminum channels, 1-1/4 by 1-1/4 inches
- F. Pickets: Extruded-aluminum tubes, 5/8 inch square, with 18ga. wall thickness, terminated at top rail.
 - 1. Picket Spacing: 4 inches clear, maximum.
- G. Finish: Baked enamel or powder coating.

1.3 GATES

- A. Aluminum Frames and Bracing: Fabricate members from square extruded-aluminum tubes 1-1/2 by 1-1/2 inches with 16 ga wall thickness.
- B. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.
- C. Finish: Baked enamel or powder coating.

1.4 CANTILEVER SLIDING GATES

- A. Decorative Aluminum cantilever sliding gates: Gates made from aluminum extrusions.
- B. Basis-of-design product is: TransPort II gate system (Classic) by Ameristar Fence Products.
- C. All industrial ornamental aluminum cantilever gates shall conform to the Ameristar® TransPort II gate system, (specify Classic, Majestic, Genesis, or Invincible) style, manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma. The project gate schedule shall include the following additional information for each cantilever gate included in the project scope: (specify nominal opening size range in feet) opening, and (specify size and shape of posts) gate posts. Contact Matt Bean at Ameristar at 888.333.3422 for information.
- D. The materials used for cantilever gate framing (i.e., uprights, diagonal braces and pickets or pales) shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with a yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish. The TransPort® Fast-Trak™ rails shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with minimum yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish.
- E. Material for diagonal bracing and uprights shall be 2" sq. x 1/4" aluminum. The design of the top and bottom enclosed track shall conform to the manufacturers 5" x 2" Fast-Trak system. Material for pickets shall be 1" x 1/8" wall aluminum.
- F. Internal roller truck assembly shall be self-aligning swivel ball-and-socket type running on four bearing wheels. Internal roller truck assembly shall be affixed to the hanger bracket by means of a 5/8" diameter industrial-grade rod end/center bolt, with a minimum static load rating of 10,000 pounds. Attachment of the center bolt to the truck body shall be by means of a swivel joint to ensure equivalent and consistent loading on all bearing wheels and internal track surfaces throughout the travel of the gate.
- G. Pickets, enclosed track, uprights and diagonal bracing shall be pre-drilled and labeled for easy assembly. All components shall be pre-cut to specified lengths.
- H. Top and bottom rail extrusions shall be mechanically fastened to vertical uprights and reinforced with diagonal braces, by drawing.
- I. The manufactured components shall be subjected to the Ameristar thermal stratification coating process (high-temperature, in-line, multi-stage, and multi-layer) including, as a minimum, a six-stage pretreatment/wash and an electrostatic spray application of a polyester finish. The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be (specify Black, Bronze, White, or Desert Sand). The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 1.

Table 1 – Coating Performance Requirements

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 3,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

EXECUTION

1.5 FENCE AND GATE INSTALLATION

- A. Install fences by setting posts as indicated and fastening rails and infill panels to posts. Peen threads of bolts after assembly to prevent removal.
- B. Post Excavation: Excavate holes to a diameter of not less than four times post size and a depth of not less than 24 inches plus 3 inches for each foot or fraction of a foot that fence height exceeds 4 feet.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 1. Posts Set in Concrete: Extend post to within 6 inches of specified excavation depth, but not closer than 3 inches to bottom of concrete.
 2. Space posts uniformly at 8 feet o.c.
- D. Install gates level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Adjust hardware for smooth operation and lubricate where necessary.

1.6 CANTILEVER GATE INSTALLATION

- A. All new gate installations shall be laid out by the contractor in accordance with the construction plans.
- B. All hardware shall be installed in accordance with the Transport installation instructions. Transport cantilever gates shall be installed so they comply with current ASTM F2200 & UL325 standards.
- C. Gate stops shall be installed on each track in a way that conforms to current ASTM F2200 standards.

- D. Gate post shall be spaced according to specified gate elevation. Posts shall be set in concrete footers having a minimum depth of 48" with a minimum diameter of 12" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.
- E. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

END OF SECTION 32 31 19

SECTION 32 32 23 - SEGMENTAL RETAINING WALLS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data and structural analysis data signed and sealed by the qualified professional engineer licensed in the State of **Kentucky** responsible for their preparation.
 - 2. Product Test Reports: Indicating compliance of retaining wall units and soil reinforcement with requirements.
 - 3. ICC-ES evaluation reports for segmental retaining wall units and soil reinforcement.
- B. Preconstruction Testing Service: Engage testing agency to perform the following:
 - 1. Test soil reinforcement and backfill for pullout resistance according to ASTM D 6706.
 - 2. Test soil reinforcement and backfill for coefficient of friction according to ASTM D 5321.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design segmental retaining walls, including comprehensive engineering analysis by a qualified professional engineer.
- B. Structural Performance: Engineering design shall be based on NCMA's "Design Manual for Segmental Retaining Walls."
- C. Seismic Performance: Engineering design shall be based on NCMA's "Segmental Retaining Walls - Seismic Design Manual."
 - 1. Horizontal Peak Ground Acceleration (A) for Project: .0034g.

2.2 RETAINING WALL MATERIALS

- A. Concrete Units: ASTM C 1372, Normal Weight, complying with requirements for freeze-thaw durability.
 - 1. Basis-of-Design Product: Tensar Earth Technologies, Inc.
 - 2. Provide units that interlock with courses above and below by means of integral lugs or lips, pins, clips or hollow cores filled with drainage fill.
 - 3. Exposed Faces: Machine-split textured.
 - 4. Shape and Dimensions: As indicated.
 - 5. Corner and Cap units and other special shapes to provide textures on exposed surfaces matching faces.
- B. Leveling Base: Per Geotechnical Report.
- C. Drainage Fill: Per Geotechnical Report.
- D. Soil Fill: Per Geotechnical Report.
- E. Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters.
- F. Soil Reinforcement: Molded high-density polyethylene geogrid or woven polyamide, polyester, or polyolefin geotextile.

1. Basis-of-Design Product: Tensar Earth Technologies, Inc.

PART 3 - EXECUTION

3.1 RETAINING WALL INSTALLATION

- A. Place and compact base material as prescribed in the Geotechnical Report.
- B. Place retaining wall units according to NCMA's "Segmental Retaining Wall Installation Guide."
 1. Place fills on both sides of wall at same time, where both sides are indicated to be filled.
 2. Fill voids with drainage fill.
- C. Cap Units: Place cap units and secure with cap adhesive.

3.2 FILL PLACEMENT

- A. Place, spread, and compact fill in uniform lifts for full width and length of embankment as wall is laid. Begin at back of wall and place and spread fill toward embankment.
 1. Compact drainage fill and reinforced soil fill as required in the Geotechnical Report, compaction methods (i.e., hand-operated compaction equipment) compatible with Manufacturer's requirements must be used within 48 inches of wall.
 2. Compact nonreinforced soil fill as prescribed in the Geotechnical Report.
- B. Embed reinforcement as prescribed by Manufacturer into precast facing units and stretch tight over compacted backfill. Anchor soil reinforcement before placing fill on it.
 1. Use additional soil reinforcement at corners and curved walls to provide continuous reinforcement per Manufacturer.
 2. Place fill material onto geosynthetics per Manufacturer's instructions.
- C. Field Quality Control: Comply with Manufacturer's requirements.
 1. In each compacted backfill layer, perform field in-place compaction test per Geotechnical Report recommendations for each prescribed segmental retaining wall length.

END OF SECTION 32 32 23

SECTION 32 84 00 - PLANTING IRRIGATION

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Shop Drawings showing sprinkler layout and flow characteristics. Include wiring diagrams.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Design 100 percent water-coverage irrigation system for lawns and exterior plants indicated.
- B. Minimum System Pressure Rating: 150 psig.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 COMPONENTS

- A. Pipe Materials: PE, ASTM F 771; PE 3408 compound; SDR 15.
 - 1. Insert Fittings: ASTM D 2609, nylon or propylene plastic.
- B. Pipe Materials: PVC pipe, ASTM D 2241, PVC 1120, SDR 26.
 - 1. Fittings: PVC plastic pipe fittings, ASTM D 2467, Schedule 80, socket type with ASTM F 656 primer and ASTM D 2564 solvent cement.
- C. Curb Valves: Bronze body, ground-key plug or ball with wide tee head.
 - 1. Basis-of-Design Product: Mueller Co. Water Products Division.
 - 2. Curb-Valve Casing: Similar to AWWA M44 for cast-iron valve casings.
- D. Bronze Gate Valves: Solid wedge; nonrising bronze stem; Class 125 bronze body and screw-in bonnet and malleable-iron, bronze, or aluminum handwheel.
 - 1. Basis-of-Design Product: American Valve, Inc.
- E. Manual Control Valves: Globe valves fitted for key operation.
- F. Automatic Control Valves: Plastic diaphragm-type, normally closed, with manual flow adjustment, and operated by 24-V ac solenoid.
 - 1. Basis-of-Design Product: Rain Bird Corporation.
- G. Automatic Drain Valves: Spring-loaded-ball type of corrosion-resistant construction and designed to open for drainage if line pressure drops below 2-1/2 to 3 psig.
- H. Antisiphon, Pressure-Type Vacuum Breakers: Spring-loaded check valve.
- I. Pressure Regulators: Single-seated, direct-operated type with integral Y-pattern strainer.
- J. Quick-Couplers: Two-piece assembly, with coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.
 - 1. Basis-of-Design Product: Rain Bird Corporation.

- K. Sprinklers: Plastic housing; flush, surface, fixed pattern, with screw-type flow adjustment.
- L. Bubblers: Fixed pattern, with screw-type flow adjustment.
 - 1. Shrubbery: Fixed pattern, with screw-type flow adjustment.
 - 2. Pop-up, Spray: Fixed pattern, with screw-type flow adjustment and stainless-steel spring.
 - 3. Pop-up, Rotary Spray: Gear drive, full-circle and adjustable part-circle type.
 - 4. Pop-up, Rotary Impact: Impact drive, full circle and part circle as indicated.
 - 5. Aboveground, Rotary Impact: Impact drive, full circle and part circle as indicated.
- M. Emitters: Plastic body with single outlet, to deliver flow at approximately 20 psig of 0.5 gph.
- N. Drip Tubes: Flexible PVC, NPS 1/2.
- O. Automatic Control System: Low-voltage system, made for control of irrigation-system automatic control valves. Controller operates on 120-V ac; provides 24-V ac power to control valves.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install components having pressure rating equal to or greater than system operating pressure.
- B. Lay piping on solid subbase, uniformly sloped without humps or depressions. Slope circuit piping down toward drain valve a minimum of 0.4 percent.
- C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone to 12 inches below grade. Cover with asphalt-saturated felt and excavated material.
- D. Minimum Cover: Provide the following minimum cover over top of buried piping:
 - 1. Pressure Piping: 24 inches.
 - 2. Circuit Piping: 12 inches.
 - 3. Drain Piping: 12 inches.
 - 4. Sleeves: 24 inches.
- E. Install water meters in meter boxes with shutoff valve on meter inlet. Include valve on meter outlet and valved bypass around meter.
- F. Install pressure regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet and valved bypass.
- G. Sprinklers: Flush circuit piping with full head of water and install sprinklers after hydrostatic test is completed.

END OF SECTION 32 84 00

Architect of Record:

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Design Architect:

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Owner:

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Contractor:

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Civil Engineers:

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Structural & MEP:

Genesis Engineering Group, Inc.
224 3rd Ave North
Franklin, TN 30764